INDEX TO VOLUME 155, PART 1

Absorption Spectra of Zn I, Cd I, and Hg I in the Vacuum Ultraviolet (Garton and Connerade), 667.

Abundances in Diffuse Nebulae (Rubin), 841.

Abundances in Two Horizontal-Branch A Stars (Kodaira, Greenstein, and Oke), 525.

Adiabatic Fluid Spheres in General Relativity. II. Massive Configurations of Ideal Gas and Radiation (Tooper), 145.

Age of the Galaxy from the Decay of Uranium (Dicke), 123.

Aizenman, Morris L., Demarque, Pierre, and Miller, R. H. On the Interpretation of the Color-Magnitude Diagrams of M67 and NGC 188, 973.

Allen, J. W , and Dupree, A. K. Calculations of Ionization Equilibria for Oxygen, Neon, Silicon, and Iron, 27.

Aller, Lawrence H. *See* Lee, Aller, Czyzak, and Duvall.

Anand, S. P. S. *See* Sackmann and Anand.

Announcements, 1135.

Arny, Thomas. Star Formation in Interstellar Clouds: Studies with a Modified Virial Theorem, 871.

Athay, R. Grant, and Skumanich, A. Theoretical Line Intensities. VII. Wavelength and Depth Dependence of Line-Blanketing Effects for Pure Absorption and Non-coherent Scattering, 273.

Bahcall, J. N. *See* Shaviv and Bahcall.

Bahcall, John N., and Kozlovsky, Ben-Zion. Some Models of the Emission-Line Region of 3C 273, 1077.

Bahcall, John N., and May, Robert M. The Rate of the Proton-Proton Reaction and Some Related Reactions, 501.

Bahcall, John N., and Moeller, Charles P. The ^{7}Be Electron-Capture Rate, 511.

Barnes, Aaron. Collisionless Heating of the Solar-Wind Plasma. II. Application of the Theory of Plasma Heating by Hydromagnetic Waves, 311.

Baschek, Bodo, and Searle, Leonard. The Chemical Composition of the Lambda Bootis Stars, 537.

Bass, Arnold M. *See* Simmons, Bass, and Tilford.

Beaudet, G., and Salpeter, E. E. Models for Carbon-Rich Stars, 203.

Becklin, E. *See* Neugebauer, Oke, Becklin, and Garmire.

Bel, L. Kinetic Theory of Cosmology, 83.

^{7}Be Electron-Capture Rate (Bahcall and Moeller), 511.

Bessell, M. S. An Investigation of Short-Period Variable Stars. I. The Delta Scuti Stars; II. The AI Velorum Stars, 1133.

Bottema, M. *See* Moos, Fastie, and Bottema.

Bracewell, R. N., Eshleman, V. R., and Hollweg, Joseph V. The Occulting Disk of the Sun at Radio Wavelengths, 367.

Brooks, Neil H. *See* Morton, Jenkins, and Brooks.

Butler, R. *See* Hughes and Butler.

Calculations of Ionization Equilibria for Oxygen, Neon, Silicon, and Iron (Allen and Dupree), 27.

Carleton, N. P., Sharma, A., Goody, R. M., Liller, W. L., and Roesler, F. L. Measurement of the Abundance of CO_2 in the Martian Atmosphere, 323.
Central Intensities of Fraunhofer Lines near Solar Minimum (Mitchell), 709.
Chamberlain, Joseph W. Escape Rate of Hydrogen from a Carbon Dioxide Atmosphere, 711.
Chandrasekhar, S. Editorial, 371.
Chemical Composition of the Lambda Bootis Stars (Baschek and Searle), 537.
Clayton, Donald D., Colgate, Stirling A., and Fishman, Gerald J. Gamma-Ray Lines from Young Supernova Remnants, 75.
Cohen, M. H., and Gundermann, E. J. Interplanetary Scintillations. IV. Observations near the Sun, 645.
Colgate, Stirling A. *See* Clayton, Colgate, and Fishman.
Collisionless Heating of the Solar-Wind Plasma. II. Application of the Theory of Plasma Heating by Hydromagnetic Waves (Barnes), 311.
Coma Cluster as a Spherical Inhomogeneity in Relativistic Dust (Kantowski), 1023.
Comparison of Some Recently Proposed Excitation and Ionization Rates (Sampson), 575.
Comstock, G. M. Propagation and Source Characteristics Derived from the Low-Energy, Multiply Charged, Cosmic-Ray Nuclei, 619.
Comstock, G. M., Fan, C. Y., and Simpson, J. A. Energy Spectra and Abundances of the Cosmic-Ray Nuclei Helium to Iron from the OGO-I Satellite Experiment, 609.
Connerade, J. P. *See* Garton and Connerade.
Conti, Peter S., and Wallerstein, George. A Search for Lithium and Beryllium in Ib Supergiants and Cepheids, 11.
Cooper, J. *See* Shen and Cooper.
Coronal Brightness at 2.23 Microns (Peterson), 1009.
Corrections in the Luminosity-Redshift Relations of the Homogeneous Friedmann Models (Kantowski), 89.
Cosmic-Ray Deuterium and Helium-3 of Secondary Origin and the Residual Modulation of Cosmic Rays (Ramaty and Lingenfelter), 587.
Cosmic-Ray Life and the Stochastic Nature of the Galactic Magnetic Field (Jokipii and Parker), 799.
Cosmologies of Bianchi Type I with a Uniform Magnetic Field (Jacobs), 379.
Cox, Donald P., and Mathews, William G. Effects of Self-Absorption and Internal Dust on Hydrogen-Line Intensities in Gaseous Nebulae, 859.
Czyzak, S. J. *See* Lee, Aller, Czyzak, and Duvall.

Demarque, Pierre. *See* Aizenman, Demarque, and Miller.
Demarque, Pierre, and Schlesinger, Barry M. On the Chemical Composition and Age of NGC 188, 965.
Dicke, R. H. The Age of the Galaxy from the Decay of Uranium, 123.
Dickel, John R., and McKinley, Raymond R. 610.5 MHz Contour Maps of the Supernova Remnants HB 9, Simeis 147, and IC 443, 67.
Dupree, A. K. *See* Allen and Dupree.
Duvall, Rhonda N. *See* Lee, Aller, Czyzak, and Duvall.
Dynamical Friction in the Post-Newtonian Approximation of General Relativity (Lee), 687.
Dynamics of the Bending of the Galaxy (Hunter and Toomre), 747.
Dyson, J. E. The High-Level Populations of Hydrogen in Gaseous Nebulae, 47.

East-West Linear Polarization Distributions of Radio Galaxies at 1418 MHz (Seielstad and Weiler), 719.

Editorial (Chandrasekhar), 371.
Effect of the Brans-Dicke Cosmology on Solar Evolution and Neutrino Fluxes (Shaviv and Bahcall), 135.
Effect of Lyman-Alpha Wing Opacity on the Temperature Scale and Helium Content for Subdwarfs (Strom and Strom), 363.
Effect of Silicon Opacity on B- and A-Star Atmospheres (Strom and Strom), 17.
Effects of Self-Absorption and Internal Dust on Hydrogen-Line Intensities in Gaseous Nebulae (Cox and Mathews), 859.
Eggen, O. J. Motions of the Bright F-Type Stars, 701.
Eggen, O. J. The Old Galactic Cluster NGC 3680, 439.
Ehlers, Jürgen, and Rienstra, William. The Locally Isotropic Solutions of the Liouville and Poisson Equations, 105.
Eliasson, Baldur. *See* Raimond and Eliasson.
Emission Lines in the Ultraviolet Spectrum of Boss 1985 (Swings), 515.
Energy Spectra and Abundances of the Cosmic-Ray Nuclei Helium to Iron from the OGO-I Satellite Experiment (Comstock, Fan, and Simpson), 609.
Escape Rate of Hydrogen from a Carbon Dioxide Atmosphere (Chamberlain), 711.
Eshleman, V. R. *See* Bracewell, Eshleman, and Hollweg.

Fan, C. Y. *See* Comstock, Fan, and Simpson.
Far-Ultraviolet Spectra of Zeta Puppis and γ^2 Velorum (Morton, Jenkins, and Brooks), 875.
Fastie, William G. *See* Moos, Fastie, and Bottema.
Fishman, Gerald J. *See* Clayton, Colgate, and Fishman.
Flare Stars in the Coal Sack (Sanduleak), 1121.
Fourth Positive System of Carbon Monoxide Observed in Absorption at High Resolution in the Vacuum Ultraviolet Region (Simmons, Bass, and Tilford), 345.

Galaxy M82. I. Analysis of the Observations (Solinger), 403.
Gamma-Ray Lines from Young Supernova Remnants (Clayton, Colgate, and Fishman), 75.
Garmire, G. *See* Neugebauer, Oke, Becklin, and Garmire.
Garton, W. R. S., and Connerade, J. P. Absorption Spectra of Zn I, Cd I, and Hg I in the Vacuum Ultraviolet, 667.
Goody, R. M. *See* Carleton, Sharma, Goody, Liller, and Roesler.
Greenstein, Jesse L. *See* Kodaira, Greenstein, and Oke.
Gundermann, E. J. *See* Cohen and Gundermann.

Hansen, James E. Radiative Transfer by Doubling Very Thin Layers, 565.
Harrington, J. Patrick. On Continuum Absorption by Heavy Elements in High-Excitation Planetary Nebulae, 1117.
Hartree-Fock Calculations of Coronal Forbidden Lines in the Argon I Isoelectronic Sequence (Wagner and House), 677.
Henry, Richard C. K-Line Photometry of A Stars, 369.
Hesser, James E., Ostriker, Jeremiah P., and Lawrence, George M. Ultrashort-Period Stellar Oscillations. III. Power-Spectrum Analysis of Photometric Observations of White Dwarfs, 919.
High-Level Populations of Hydrogen in Gaseous Nebulae (Dyson), 47.
Hodge, Paul W. H II Regions in Twenty Nearby Galaxies, 369.
Hodge, Paul W. The Radial Distribution of H II Regions in Spiral Galaxies, 417.
Hogg, David E. The Structure of Quasi-Stellar Radio Sources, 1099.

Hollweg, Joseph V. *See* Bracewell, Eshleman, and Hollweg.
Houck, J. R. *See* Werner, Pipher, Terzian, and Houck.
House, Lewis L. *See* Wagner and House.
Hubbard, W. B. Thermal Models of Jupiter and Saturn, 333.
Hughes, V. A., and Butler, R. The Radio Nebula NRAO 591/593, 1061.
Hunter, C., and Toomre, Alar. Dynamics of the Bending of the Galaxy, 747.
H II Regions in Twenty Nearby Galaxies (Hodge), 369.

Interplanetary Scintillations. IV. Observations near the Sun (Cohen and Gundermann), 645.
Investigation of Short-Period Variable Stars. I. The Delta Scuti Stars; II. The AI Velorum Stars (Bessell), 1133.

Jacobs, Kenneth C. Cosmologies of Bianchi Type I with a Uniform Magnetic Field, 379.
Jenkins, Edward B. *See* Morton, Jenkins, and Brooks.
Jokipii, J. R., and Parker, E. N. Cosmic-Ray Life and the Stochastic Nature of the Galactic Magnetic Field, 799.
Jokipii, J. R., and Parker, E. N. Stochastic Aspects of Magnetic Lines of Force with Application to Cosmic-Ray Propagation, 777.
Julian, William H. Overstability of Thin Stellar Systems, 117.

Kaftan-Kassim, May A. A Survey of High-Frequency Radio Radiation from Planetary Nebulae, 469.
Kantowski, R. Corrections in the Luminosity-Redshift Relations of the Homogeneous Friedmann Models, 89.
Kantowski, Ronald. The Coma Cluster as a Spherical Inhomogeneity in Relativistic Dust, 1023.
Kinetic Theory of Cosmology (Bel), 83.
K-Line Photometry of A Stars (Henry), 369.
Kodaira, K., Greenstein, Jesse L., and Oke, J. B. Abundances in Two Horizontal-Branch A Stars, 525.
Kozlovsky, Ben-Zion. *See* Bahcall and Kozlovsky.
Kundu, M. R., and Velusamy, T. Polarized Brightness Distributions of Supernova Remnants IC 443 and W44 at 6-cm Wavelength, 807.

Late Phases of Stellar Evolution. I. Pure Iron Stars (Savedoff, Van Horn, and Vila), 221.
Lawrence, George M. *See* Hesser, Ostriker, and Lawrence.
Lee, Edward P. Dynamical Friction in the Post-Newtonian Approximation of General Relativity, 687.
Lee, Paul, Aller, Lawrence H., Czyzak, S. J., and Duvall, Rhonda N. Spectrophotometric Studies of Gaseous Nebulae. XII. The Symmetrical Planetary IC 3568, 853.
Liller, William. On the Optical Polarization of Three Quasi-stellar Objects, 1113.
Liller, W. L. *See* Carlton, Sharma, Goody, Liller, and Roesler.
Lin, C. C., Yuan, C., and Shu, Frank H. On the Spiral Structure of Disk Galaxies. III. Comparison with Observations, 721.
Lingenfelter, Richard E. *See* Ramaty and Lingenfelter.
Locally Isotropic Solutions of the Liouville and Poisson Equations (Ehlers and Rienstra), 105.
Log N–log S Relation and Luminosity Functions for Radio Sources in Friedmann Universes (Petrosian), 1029.
Low-Frequency Absorption due to IC 1805 and IC 1848 (Roger), 831.
Luyten, Willem J. *See* Sandage and Luyten.
Lyman-Line Decrements in Low-Density Planetary Nebulae (Walmsley and Mathews), 57.

McKinley, Raymond R. *See* Dickel and McKinley.
Mathews, W. G. *See* Walmsley and Mathews.
Mathews, William G. *See* Cox and Mathews.
May, Robert M. *See* Bahcall and May.
Measurement of the Abundance of CO_2 in the Martian Atmosphere (Carleton, Sharma, Goody, Liller, and Roesler), 323.
Measurement of Chromospheric Heights (Mitchell), 665.
Miller, R. H. *See* Aizenman, Demarque, and Miller.
Mitchell, Walter E., Jr. The Central Intensities of Fraunhofer Lines near Solar Minimum, 709.
Mitchell, Walter E., Jr. The Measurement of Chromospheric Heights, 665.
Mjolsness, Raymond C. Solutions to the Vlasov Equation for Newtonian Cosmologies, 697.
Model Atmospheres for Yellow Supergiants (Parsons), 719.
Models for Carbon-Rich Stars (Beaudet and Salpeter), 203.
Moeller, Charles P. *See* Bahcall and Moeller.
Moos, H. Warren, Fastie, William G., Bottema, M. Rocket Measurement of Ultraviolet Spectra of Venus and Jupiter between 1200 and 1800 Å, 887.
Morton, Donald C., Jenkins, Edward B., and Brooks, Neil H. Far-Ultraviolet Spectra of Zeta Puppis and γ^2 Velorum, 875.
Motions of the Bright F-Type Stars (Eggen), 701.
Mourad, S. A., and Siewert, C. E. On Solutions of an Equation of Transfer for a Planetary Atmosphere, 555.

Nakagawa, Y., and Swarztrauber, P. The Topology of an Axisymmetric Magnetic Field of a Differentially Rotating Sun, 295.
Neugebauer, G., Oke, J. B., Becklin, E., and Garmire, G. A Study of Visual and Infrared Observations of Sco XR-1, 1.
Neutrino Emission and the Onset of Carbon Burning (Rose), 491.
Non-radial Pulsation of General-Relativistic Stellar Models. II. Properties of the Gravitational Waves (Price and Thorne), 163.
Nuclear Reaction Rates at High Densities (Salpeter and Van Horn), 183.
Nutku, Yavuz. The Post-Newtonian Equations of Hydrodynamics in the Brans-Dicke Theory, 999.

Observations of the Total Lunar Eclipse of October 18, 1967, at a Wavelength of 3.33 Millimeters (Rusch, Slobin, Stelzried, and Sato), 1017.
Occulting Disk of the Sun at Radio Wavelengths (Bracewell, Eshleman, and Hollweg), 367.
Oke, J. B. *See* Kodaira, Greenstein, and Oke.
Oke, J. B. *See* Neugebauer, Oke, Becklin, and Garmire.
Old Galactic Cluster NGC 3680 (Eggen), 439.
On the Albedo Problem for a Finite Plane-Parallel Rayleigh-Scattering Atmosphere (Shieh and Siewert), 265.
On the Chemical Composition and Age of NGC 188 (Demarque and Schlesinger), 965.
On Continuum Absorption by Heavy Elements in High-Excitation Planetary Nebulae (Harrington), 1117.
On the Determination of the Slope from Radio-Source Counts (Refsdal), 373.
On the Equation of Radiative Transfer in a Magnetoactive Plasma (Zheleznyakov), 1129.
On the Interpretation of the Color-Magnitude Diagrams of M67 and NGC 188 (Aizenman, Demarque, and Miller), 973.
On the Nature of Faint Blue Objects in High Galactic Latitudes. II. Summary of Photometric Results for 301 Objects in Seven Survey Fields (Sandage and Luyten), 913.

On the Optical Polarization of Three Quasi-stellar Objects (Liller), 1113.
On the Oscillations and Stability of Rotating Stellar Models. II. Rapidly Rotating White Dwarfs (Ostriker and Tassoul), 987.
On the Solution of the Transfer Equation for Continuum Radiation in Inhomogeneous Atmospheres (Wilson), 715.
On Solutions of an Equation of Transfer for a Planetary Atmosphere (Mourad and Siewert), 555.
On the Spiral Structure of Disk Galaxies. III. Comparison with Observations (Lin, Yuan, and Shu), 721.
On Strong Collisions in Hydrogenic Line Broadening (Shen and Cooper), 37.
Origin of the Angular Momentum of Galaxies (Peebles), 393.
Ostriker, Jeremiah P. *See* Hesser, Ostriker, and Lawrence.
Ostriker, Jeremiah P., and Tassoul, Jean Louis. On the Oscillations and Stability of Rotating Stellar Models. II. Rapidly Rotating White Dwarfs, 987.
Overstability of Thin Stellar Systems (Julian), 117.
[O III] Temperature for One "Filament" in the Cygnus Loop (Parker), 359.

Parker, E. N. *See* Jokipii and Parker.
Parker, Robert A. R. The [O III] Temperature for One "Filament" in the Cygnus Loop, 359.
Parsons, Sidney B. Model Atmospheres for Yellow Supergiants, 719.
Paschen-Line Observations of the Orion Nebula (Werner, Pipher, Terzian, and Houck), 485.
Peebles, P. J. E. Origin of the Angular Momentum of Galaxies, 393.
Peterson, Alan W. The Coronal Brightness at 2.23 Microns, 1009.
Petrosian, Vahé. The log N–log S Relation and Luminosity Functions for Radio Sources in Friedmann Universes, 1029.
Pipher, Judith L., and Terzian, Yervant. Reddening Curves for Planetary Nebulae, 475.
Pipher, Judith L. *See* Werner, Pipher, Terzian, and Houck.
Polarized Brightness Distributions of Supernova Remnants IC 443 and W44 at 6-cm Wavelength (Kundu and Velusamy), 807.
Positions and Stokes Parameters of Seven OH-Emission Sources (Raimond and Eliasson), 817.
Post-Newtonian Equations of Hydrodynamics in the Brans-Dicke Theory (Nutku), 999.
Price, Richard, and Thorne, Kip S. Non-radial Pulsation of General-Relativistic Stellar Models. II. Properties of the Gravitational Waves, 163.
Production of Cosmic Gamma Rays by Compton Scattering in Discrete Sources (Rieke and Weekes), 429.
Propagation and Source Characteristics Derived from the Low-Energy, Multiply Charged, Cosmic-Ray Nuclei (Comstock), 619.
Pulsational Instabilities in Hydrogen-Poor Massive Blue Stars. I (Simon and Stothers), 247.

Radial Distribution of H II Regions in Spiral Galaxies (Hodge), 417.
Radiative Transfer by Doubling Very Thin Layers (Hansen), 565.
Radio Nebula NRAO 591/593 (Hughes and Butler), 1061.
Raimond, Ernst, and Eliasson, Baldur. Positions and Stokes Parameters of Seven OH-Emission Sources, 817.
Ramaty, Reuven, and Lingenfelter, Richard E. Cosmic-Ray Deuterium and Helium-3 of Secondary Origin and the Residual Modulation of Cosmic Rays, 587.
Rate of the Proton-Proton Reaction and Some Related Reactions (Bahcall and May), 501.
Red Supergiants and Neutrino Emission (Stothers), 935.
Reddening Curves for Planetary Nebulae (Pipher and Terzian), 475.

Refsdal, Sjur. On the Determination of the Slope from Radio-Source Counts, 373.
Rieke, G. H., and Weekes, T. C. Production of Cosmic Gamma Rays by Compton Scattering in Discrete Sources, 429.
Rienstra, William. *See* Ehlers and Rienstra.
Rocket Measurement of Ultraviolet Spectra of Venus and Jupiter between 1200 and 1800 Å (Moos, Fastie, and Bottema), 887.
Roeder, R. C., and Verreault, R. T. The Screening of Distant Objects in Universes with Positive Cosmological Constant, 1047.
Roesler, F. L. *See* Carleton, Sharma, Goody, Liller, and Roesler.
Roger, R. S. Low-Frequency Absorption due to IC 1805 and IC 1848, 831.
Rose, William K. Neutrino Emission and the Onset of Carbon Burning, 491.
Rubin, Robert H. Abundances in Diffuse Nebulae, 841.
Rusch, W. V. T., Slobin, S. D., Stelzried, C. T., and Sato, T. Observations of the Total Lunar Eclipse of October 18, 1967, at a Wavelength of 3.33 Millimeters, 1017.

Sackmann, I. J., and Anand, S. P. S. Slowly Rotating Convective Models with Radiation Pressure, 257.
Salpeter, E. E. *See* Beaudet and Salpeter.
Salpeter, E. E., and Van Horn, H. M. Nuclear Reaction Rates at High Densities, 183.
Sampson, Douglas H. Comparison of Some Recently Proposed Excitation and Ionization Rates, 575.
Sandage, Allan, and Luyten, Willem J. On the Nature of Faint Blue Objects in High Galactic Latitudes. II. Summary of Photometric Results for 301 Objects in Seven Survey Fields, 913.
Sanduleak, N. Flare Stars in the Coal Sack, 1121.
Sato, T. *See* Rusch, Slobin, Stelzried, and Sato.
Savedoff, M. P., Van Horn, H. M., and Vila, S. C. Late Phases of Stellar Evolution. I. Pure Iron Stars, 221.
Schlesinger, Barry M. *See* Demarque and Schlesinger.
Screening of Distant Objects in Universes with Positive Cosmological Constant (Roeder and Verreault), 1047.
Search for Lithium and Beryllium in Ib Supergiants and Cepheids (Conti and Wallerstein), 11.
Searle, Leonard. *See* Baschek and Searle.
Sears, R. L., and Whitford, A. E. Six-Color Photometry of Stars. XII. Colors of Hyades and Subdwarf Stars, 899.
Seielstad, G. A., and Weiler, K. W. East-West Linear Polarization Distributions of Radio Galaxies at 1418 MHz, 719.
Sharma, A. *See* Carleton, Sharma, Goody, Liller, and Roesler.
Shaviv, G., and Bahcall, J. N. The Effect of the Brans-Dicke Cosmology on Solar Evolution and Neutrino Fluxes, 135.
Shen, K. Y., and Cooper, J. On Strong Collisions in Hydrogenic Line Broadening, 37.
Shieh, P. S., and Siewert, C. E. On the Albedo Problem for a Finite Plane-Parallel Rayleigh-Scattering Atmosphere, 265.
Shu, Frank H. *See* Lin, Yuan, and Shu.
Siewert, C. E. *See* Mourad and Siewert.
Siewert, C. E. *See* Shieh and Siewert.
Simmons, J. D., Bass, Arnold M., and Tilford, S. G. The Fourth Positive System of Carbon Monoxide Observed in Absorption at High Resolution in the Vacuum Ultraviolet Region, 345.
Simon, Norman R., and Stothers, Richard. Pulsational Instabilities in Hydrogen-Poor Massive Blue Stars. I, 247.

Simpson, E. *See* Torres-Peimbert, Simpson, and Ulrich.
Simpson, J. A. *See* Comstock, Fan, and Simpson.
Six-Color Photometry of Stars. XII. Colors of Hyades and Subdwarf Stars (Sears and Whitford), 899.
610.5 MHz Contour Maps of the Supernova Remnants HB 9, Simeis 147, and IC 443 (Dickel and McKinley), 67.
Skumanich, A. *See* Athay and Skumanich.
Slattery, J. C. *See* Tagliaferri and Slattery.
Slobin, S. D. *See* Rusch, Slobin, Stelzried, and Sato.
Slowly Rotating Convective Models with Radiation Pressure (Sackmann and Anand), 257.
Solinger, Alan B. The Galaxy M82. I. Analysis of the Observations, 403.
Solutions to the Vlasov Equation for Newtonian Cosmologies (Mjolsness), 697.
Some Models of the Emission-Line Region of 3C 273 (Bahcall and Kozlovsky), 1077.
Spectral Measurement of Simulated Meteors (Tagliaferri and Slattery), 1123.
Spectrophotometric Studies of Gaseous Nebulae. XII. The Symmetrical Planetary IC 3568 (Lee, Aller, Czyzak, and Duvall), 853.
Star Formation in Interstellar Clouds: Studies with a Modified Virial Theorem (Arny), 871.
Stelzried, C. T. *See* Rusch, Slobin, Stelzried, and Sato.
Stochastic Aspects of Magnetic Lines of Force with Application to Cosmic-Ray Propagation (Jokipii and Parker), 777.
Stothers, Richard. Red Supergiants and Neutrino Emission, 935.
Stothers, Richard. *See* Simon and Stothers.
Strom, K. M. *See* Strom and Strom.
Strom, S. E., and Strom, K. M. The Effect of Lyman-Alpha Wing Opacity on the Temperature Scale and Helium Content for Subdwarfs, 363.
Strom, S. E., and Strom, K. M. Effect of Silicon Opacity on B- and A-Star Atmospheres, 17.
Structure of Quasi-stellar Radio Sources (Hogg), 1099.
Studies of Extremely Young Clusters. V. Stars in the Vicinity of the Orion Nebula (Walker), 447.
Studies in Stellar Evolution. VII. Solar Models (Torres-Peimbert, Simpson, and Ulrich), 957.
Study of Visual and Infrared Observations of Sco XR-1 (Neugebauer, Oke, Becklin, and Garmire), 1.
Survey of High-Frequency Radio Radiation from Planetary Nebulae (Kaftan-Kassim), 469.
Swarztrauber, P. *See* Nakagawa and Swarztrauber.
Swings, Jean Pierre. The Emission Lines in the Ultraviolet Spectrum of Boss 1985, 515.

Tagliaferri, E., and Slattery, J. C. A Spectral Measurement of Simulated Meteors, 1123.
Tassoul, Jean Louis. *See* Ostriker and Tassoul.
Terzian, Yervant. *See* Pipher and Terzian.
Terzian, Yervant. *See* Werner, Pipher, Terzian, and Houck.
Theoretical Line Intensities. VII. Wavelength and Depth Dependence of Line-Blanketing Effects for Pure Absorption and Non-coherent Scattering (Athay and Skumanich), 273.
Thermal Models of Jupiter and Saturn (Hubbard), 333.
Thorne, Kip S. *See* Price and Thorne.
Tilford, S. G. *See* Simmons, Bass, and Tilford.
Toomre, Alar. *See* Hunter and Toomre.
Tooper, Robert F. Adiabatic Fluid Spheres in General Relativity. II. Massive Configurations of Ideal Gas and Radiation, 145.

Topology of an Axisymmetric Magnetic Field of a Differentially Rotating Sun (Nakagawa and Swarztrauber), 295.
Torres-Peimbert, S., Simpson, E., and Ulrich, R. K. Studies in Stellar Evolution. VII. Solar Models, 957.

Ulrich, R. K. *See* Torres-Peimbert, Simpson, and Ulrich.
Ultrashort-Period Stellar Oscillations. III. Power-Spectrum Analysis of Photometric Observations of White Dwarfs (Hesser, Ostriker, and Lawrence), 919.

Van Horn, H. M. *See* Salpeter and Van Horn.
Van Horn, H. M. *See* Savedoff, Van Horn, and Vila.
Velusamy, T. *See* Kundu and Velusamy.
Verreault, R. T. *See* Roeder and Verreault.
Vila, S. C. *See* Savedoff, Van Horn, and Vila.

Wagner, William J., and House, Lewis L. Hartree-Fock Calculations of Coronal Forbidden Lines in the Argon I Isoelectronic Sequence, 677.
Walker, Merle F. Studies of Extremely Young Clusters. V. Stars in the Vicinity of the Orion Nebula, 447.
Wallerstein, George. *See* Conti and Wallerstein.
Walmsley, C. M., and Mathews, W. G. Lyman-Line Decrements in Low-Density Planetary Nebulae, 57.
Weekes, T. C. *See* Rieke and Weekes.
Weiler, K. W. *See* Seielstad and Weiler.
Werner, Michael W., Pipher, Judith L., Terzian, Yervant, and Houck, J. R. Paschen-Line Observations of the Orion Nebula, 485.
Whitford, A. E. *See* Sears and Whitford.
Wilson, P. R. On the Solution of the Transfer Equation for Continuum Radiation in Inhomogeneous Atmospheres, 715.

Yuan, C. *See* Lin, Yuan, and Shu.

Zheleznyakov, V. V. On the Equation of Radiative Transfer in a Magnetoactive Plasma, 1129.

INDEX TO VOLUME 155, PART 2

Ables, J. G. Possible Time Variation of the Radio Emission from Sco X-1, L27.

Absorption Redshifts in the Quasi-stellar Objects PHL 5200 and B194 (Burbidge), L43.

Allen, D. A. *See* Ney and Allen.

Astrophysical Consequences of Dirac's Hypothesis of a Variable Gravitational Number (Dehnen and Hönl), L35.

Bahcall, John N. *See* Petrosian, Bahcall, and Salpeter.

Bartlett, J. F. *See* Eliasson and Bartlett.

Baxter, A. J., Wilson, B. G., and Green, D. W. The Diffuse X-Radiation Spectrum below 4 keV, L145.

Becklin, E. E. *See* Westphal, Kristian, Snellen, Sandage, Schmidt, Oke, Neugebauer, and Becklin.

Berger, Richard A., and Bruner, Elmo C., Jr. Solar C II Resonance-Line Profiles, L115.

Bortolot, V. J., Jr., and Thaddeus, P. Probable Detection of Interstellar $C^{13}H^+$, L17.

Bruner, Elmo C., Jr. *See* Berger and Bruner.

Buhl, David. *See* Snyder and Buhl.

Burbidge, E. Margaret. Absorption Redshifts in the Quasi-stellar Objects PHL 5200 and B194, L43.

Burlaga, L. F., Ogilvie, K. W., and Fairfield, D. H. Microscale Fluctuations in the Interplanetary Magnetic Field, L171.

Carr, T. D., Omer, G. C., Jr., Lebo, G. R., and Davis, R. W. Radio and Optical Observations of the Hercules Cluster of Galaxies, L127.

Central Convection and Solar Neutrinos (Iben), L101.

Changes in Polarization of the R Coronae Borealis Star RY Sagittarii (Serkowski and Kruszewski), L15.

Circumstellar Infrared Emission from Cool Stars (Woolf and Ney), L181.

Circumstellar Infrared Emission from Two Peculiar Objects—R Aquarii and R Coronae Borealis (Stein, Gaustad, Gillett, and Knacke), L3.

Comparison of the Nuclei in M51 and NGC 4151 (Weedman), L129.

Conti, Peter S. Stellar Li/Be and Li^6/Li^7 Ratios, L167.

Continuum of BL Lac (Visvanathan), L133.

Corbett, H. H. *See* Hobbs, Corbett, and Santini.

Cosmic-Ray Heating of the Interstellar Gas (Field, Goldsmith, and Habing), L149.

Cudaback, D. D., and Heiles, C. A Survey of Dust Clouds for OH Emission, L21.

Cudaback, David D., and Welch, William J. The Occultation Position of an OH Emission Source in W24, L83.

Davis, R. W. *See* Carr, Omer, Lebo, and Davis.

Dehnen, H., and Hönl, H. Astrophysical Consequences of Dirac's Hypothesis of a Variable Gravitational Number, L35.

Detection of the 12.8-Micron Ne^+ Emission Line from the Planetary Nebula IC 418 (Gillett and Stein), L97.

Detection of X-Rays from the Large Magellanic Cloud (Mark, Price, Rodrigues, Seward, and Swift), L143.

Diffuse X-Radiation Spectrum below 4 keV (Baxter, Wilson, and Green), L145.
Discovery of an Intense OH Emission Source (Eliasson and Bartlett), L79.

Eliasson, B., and Bartlett, J. F. Discovery of an Intense OH Emission Source, L79.
Ellis, D. V. *See* Haymes, Ellis, Fishman, Glenn, and Kurfess.
Extremely Red Star in the Region of the Young Open Cluster NGC 6231 (Seggewiss), L1.

Fairfield, D. H. *See* Burlaga, Ogilvie, and Fairfield.
Far-Infrared Observation of the Galactic-Center Region at 100 Microns (Hoffmann and Frederick), L9.
Field, G. B., Goldsmith, D. W., and Habing, H. J. Cosmic-Ray Heating of the Interstellar Gas, L149.
Fine-Structure Transitions and the Background Microwave Radiation (Petrosian, Bahcall, and Salpeter), L57.
Finzi, A., and Wolf, R. A. Possible Conversion of Rotational Energy of the Neutron Star in the Crab Nebula into Energy of Relativistic Electrons, L107.
Fishman, G. J. *See* Haymes, Ellis, Fishman, Glenn, and Kurfess.
Flux Density of Taurus A at 4.3-Mm Wavelength (Hobbs, Corbett, and Santini), L87.
Frederick, Carl L. *See* Hoffmann and Frederick.
Further Spectroscopic Observations of the Optical Object Identified with X-Ray Source Cygnus X-2 (Kraft and Miller), L159.

Gaustad, J. E. *See* Knacke, Gaustad, Gillett, and Stein.
Gaustad, John E. *See* Stein, Gaustad, Gillett, and Knacke.
Gillett, F. C. *See* Knacke, Gaustad, Gillett, and Stein.
Gillett, F. C. *See* Stein, Gaustad, Gillett, and Knacke.
Gillett, F. C. *See* Stein and Gillett.
Gillett, F. C., and Stein, W. A. Detection of the 12.8-Micron Ne^+ Emission Line from the Planetary Nebula IC 418, L97.
Gilman, Robert C. On the Composition of Circumstellar Grains, L185.
Glenn, S. W. *See* Haymes, Ellis, Fishman, Glenn, and Kurfess.
Goldsmith, D. W. *See* Field, Goldsmith, and Habing.
Golson, J. C. *See* Johnson and Golson.
Green, D. W. *See* Baxter, Wilson, and Green.
Greenberg, D. W. A Radio Observational Test for Low-Energy Cosmic Rays in the Galaxy, L51.

Habing, H. J. *See* Field, Goldsmith, and Habing.
Haymes, R. C., Ellis, D. V., Fishman, G. J., Glenn, S. W., and Kurfess, J. D. Search for Gamma Radiation from Centaurus A, L31.
Heiles, C. *See* Cudaback and Heiles.
Heiles, C. *See* Seling and Heiles.
Hobbs, R. W., Corbett, H. H., and Santini, N. J. The Flux Density of Taurus A at 4.3-Mm Wavelength, L87.
Hönl, H. *See* Dehnen and Hönl.
Hoffmann, William F., and Frederick, Carl L. Far-Infrared Observation of the Galactic-Center Region at 100 Microns, L9.

Iben, Icko, Jr. Central Convection and Solar Neutrinos, L101.
Infrared Sources in the Trapezium Region of M42 (Ney and Allen), L193.

Janes, K., and Lynds, R. Photometric Selection of Quasi-stellar Objects, L47.
Johnson, H. M., and Golson, J. C. Narrow-Band Photometry of Five Combination-Variable Stars and the X-Ray Source Cyg X-2, L91.

Kellermann, K. I., and Pauliny-Toth, I. I. K. The Spectra of Opaque Radio Sources, L71.
Knacke, R. F. *See* Stein, Gaustad, Gillett, and Knacke.
Knacke, R. F., Gaustad, J. E., Gillett, F. C., and Stein, W. A. A Possible Identification of Interstellar Silicate Absorption in the Infrared Spectrum of 119 Tauri, L189.
Kraft, Robert P., and Miller, Joseph S. Further Spectroscopic Observations of the Optical Object Identified with X-Ray Source Cygnus X-2, L159.
Kristian, Jerome. *See* Westphal, Kristian, Snellen, Sandage, Schmidt, Oke, Neugebauer, and Becklin.
Kruszewski, A. *See* Serkowski and Kruszewski.
Kurfess, J. D. *See* Haymes, Ellis, Fishman, Glenn, and Kurfess.

Lebo, G. R. *See* Carr, Omer, Lebo, and Davis.
Lynds, R. *See* Janes and Lynds.
Lynds, R., Maran, S. P., and Trumbo, D. E. Optical Identification and Observations of the Pulsar NP 0532, L121.

Magnetic Fields in Interstellar Neutral-Hydrogen Clouds (Verschuur), L155.
Maran, S. P. *See* Lynds, Maran, and Trumbo.
Mark, Hans, Price, R., Rodrigues, R., Seward, F. D., and Swift, C. D. Detection of X-Rays from the Large Magellanic Cloud, L143.
Microscale Fluctuations in the Interplanetary Magnetic Field (Burlaga, Ogilvie, and Fairfield), L17.
Miller, Joseph S. *See* Kraft and Miller.

Narrow-Band Photometry of Five Combination-Variable Stars and the X-Ray Source Cyg X-2 (Johnson and Golson), L91.
Neugebauer, Gerry. *See* Westphal, Kristian, Snellen, Sandage, Schmidt, Oke, Neugebauer, and Becklin.
Ney, E. P. *See* Woolf and Ney.
Ney, E. P., and Allen, D. A. The Infrared Sources in the Trapezium Region of M42, L193.
Numerology and Local Quasi-stellar Objects (Smernoff), L139.

Occultation Position of an OH Emission Source in W24 (Cudaback and Welch), L83.
Ogilvie, K. W. *See* Burlaga, Ogilvie, and Fairfield.
Oke, J. B. *See* Westphal, Kristian, Snellen, Sandage, Schmidt, Oke, Neugebauer, and Becklin.
Omer, G. C., Jr. *See* Carr, Omer, Lebo, and Davis.
On the Composition of Circumstellar Grains (Gilman), L185.
On the Nature of Ryle and Bailey's Candidate Star for the Pulsating Radio Source CP 1919 (Westphal, Kristian, Snellen, Sandage, Schmidt, Oke, Neugebauer, and Becklin), L109.
Optical Identification and Observation of the Pulsar NP 0532 (Lynds, Maran, and Trumbo), L121.

Parks, G. K., and Winckler, J. R. Sixteen-Second Periodic Pulsations Observed in the Correlated Microwave and Energetic X-Ray Emission from a Solar Flare, L117.
Pauliny-Toth, I. I. K. *See* Kellermann and Pauliny-Toth.
Petrosian, Vahé, Bahcall, John N., and Salpeter, E. E. Fine-Structure Transitions and the Background Microwave Radiation, L57.
Photometric Selection of Quasi-stellar Objects (Janes and Lynds), L47.
Possible Conversion of Rotational Energy of the Neutron Star in the Crab Nebula into Energy of Relativistic Electrons (Finzi and Wolf), L107.
Possible Identification of Interstellar Silicate Absorption in the Infrared Spectrum of 119 Tauri (Knacke, Gaustad, Gillett, and Stein), L189.
Possible Time Variation of the Radio Emission from Sco X-1 (Ables), L27.

Price, R. *See* Mark, Price, Rodrigues, Seward, and Swift.
Probable Detection of Interstellar $C^{13}H^+$ (Bortolot and Thaddeus), L17.

Radio Observational Test for Low-Energy Cosmic Rays in the Galaxy (Greenberg), L51.
Radio and Optical Observations of the Hercules Cluster of Galaxies (Carr, Omer, Lebo, and Davis), L127.
Rodrigues, R. *See* Mark, Price, Rodrigues, Seward, and Swift.

Salpeter, E. E. *See* Petrosian, Bahcall, and Salpeter.
Sandage, Allan. *See* Westphal, Kristian, Snellen, Sandage, Schmidt, Oke, Neugebauer, and Becklin.
Santini, N. J. *See* Hobbs, Corbett, and Santini.
Schmidt, Maarten. *See* Westphal, Kristian, Snellen, Sandage, Schmidt, Oke, Neugebauer, and Becklin.
Search for Gamma Radiation from Centaurus A (Haymes, Ellis, Fishman, Glenn, and Kurfess), L31.
Seggewiss, Wilhelm. An Extremely Red Star in the Region of the Young Open Cluster NGC 6231, L1.
Seling, T. V., and Heiles, C. An Upper Limit to the Abundance of He^3 in Messier 17, L163.
Serkowski, K., and Kruszewski, A. Changes in Polarization of the R Coronae Borealis Star RY Sagittarii, L15.
Seward, F. D. *See* Mark, Price, Rodrigues, Seward, and Swift.
Sixteen-Second Periodic Pulsations Observed in the Correlated Microwave and Energetic X-Ray Emission from a Solar Flare (Parks and Winckler), L117.
Smernoff, Barry J. Numerology and Local Quasi-stellar Objects, L139.
Snellen, Grant. *See* Westphal, Kristian, Snellen, Sandage, Schmidt, Oke, Neugebauer, and Becklin.
Snyder, Lewis E., and Buhl, David. Water-Vapor Clouds in the Interstellar Medium, L65.
Solar C II Resonance-Line Profiles (Berger and Bruner), L115.
Spectra of Opaque Radio Sources (Kellermann and Pauliny-Toth), L71.
Spectral Distribution of Infrared Radiation from the Trapezium Region of the Orion Nebula (Stein and Gillett), L197.
Spectroscopy of a New, Faint Quasi-stellar Object (Stockton), L141.
Spectrum of NML Cygnus from 7.5 to 14 Microns (Stein, Gaustad, Gillett, and Knacke), L177.
Stein, W. A. *See* Gillett and Stein.
Stein, W. A. *See* Knacke, Gaustad, Gillett, and Stein.
Stein, Wayne A., Gaustad, John E., Gillett, F. C., and Knacke, R. F. Circumstellar Infrared Emission from Two Peculiar Objects—R Aquarii and R Coronae Borealis, L3.
Stein, Wayne A., Gaustad, John E., Gillett, F. C., and Knacke, R. F. The Spectrum of NML Cygnus from 7.5 to 14 Microns, L177.
Stein, Wayne A., and Gillett, F. C. Spectral Distribution of Infrared Radiation from the Trapezium Region of the Orion Nebula, L197.
Stellar Li/Be and Li^6/Li^7 Ratios (Conti), L167.
Stockton, Alan. Spectroscopy of a New, Faint Quasi-stellar Object, L141.
Survey of Dust Clouds for OH Emission (Cudaback and Heiles), L21.
Swift, C. D. *See* Mark, Price, Rodrigues, Seward, and Swift.

Thaddeus, P. *See* Bortolot and Thaddeus.
Trumbo, D. E. *See* Lynds, Maran, and Trumbo.

Upper Limit to the Abundance of He^3 in Messier 17 (Seling and Heiles), L163.

Verschuur, G. L. Magnetic Fields in Interstellar Neutral-Hydrogen Clouds, L155.
Visvanathan, N. The Continuum of BL Lac, L133.

Water-Vapor Clouds in the Interstellar Medium (Snyder and Buhl), L65.
Weedman, Daniel W. A Comparison of the Nuclei in M51 and NGC 4151, L129.
Welch, William J. *See* Cudaback and Welch.
Westphal, J. A., Kristian, Jerome, Snellen, Grant, Sandage, Allan, Schmidt, Maarten, Oke, J. B., Neugebauer, Gerry, and Becklin, E. E. On the Nature of Ryle and Bailey's Candidate Star for the Pulsating Radio Source CP 1919, L109.
Wilson, B. G. *See* Baxter, Wilson, and Green.
Winckler, J. R. *See* Parks and Winckler.
Woolf, N. J., and Ney, E. P. Circumstellar Infrared Emission from Cool Stars, L181.

THE ASTROPHYSICAL JOURNAL

FOUNDED IN 1895 BY GEORGE E. HALE AND JAMES E. KEELER

Published in Collaboration with the American Astronomical Society

S. CHANDRASEKHAR
Managing Editor
University of Chicago

EDITORIAL BOARD

MAARTEN SCHMIDT (1969–73)
California Institute of Technology

DONALD E. OSTERBROCK (1967–71)
Washburn Observatory

L. WOLTJER (1968–72)
Columbia University

GEORGE W. PRESTON (1966–70)
Mount Wilson and Palomar Observatories

EDWIN E. SALPETER (1965–69)
Cornell University

Editorial Assistant: JEANETTE R. BURNETT

VOLUME 155, PART 1

JANUARY–MARCH 1969

THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS

COPYRIGHT 1969
BY THE UNIVERSITY OF CHICAGO
PUBLISHED MONTHLY

COMPOSED AND PRINTED BY THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS, U.S.A.

CONTENTS, PART 1

NUMBER 1

A Study of Visual and Infrared Observations of Sco XR-1
G. Neugebauer, J. B. Oke, E. Becklin, and G. Garmire 1

A Search for Lithium and Beryllium in Ib Supergiants and Cepheids
Peter S. Conti and George Wallerstein 11

Effect of Silicon Opacity on B- and A-Star Atmospheres
S. E. Strom and K. M. Strom 17

Calculations of Ionization Equilibria for Oxygen, Neon, Silicon, and Iron
J. W. Allen and A. K. Dupree 27

On Strong Collisions in Hydrogenic Line Broadening
K. Y. Shen and J. Cooper 37

The High-Level Populations of Hydrogen in Gaseous Nebulae . . J. E. Dyson 47

Lyman-Line Decrements in Low-Density Planetary Nebulae
C. M. Walmsley and W. G. Mathews 57

610.5 MHz Contour Maps of the Supernova Remnants HB 9, Simeis 147, and IC 443 . . . . . John R. Dickel and Raymond R. McKinley 67

Gamma-Ray Lines from Young Supernova Remnants
Donald D. Clayton, Stirling A. Colgate, and Gerald J. Fishman 75

Kinetic Theory of Cosmology . . . . . L. Bel 83

Corrections in the Luminosity-Redshift Relations of the Homogeneous Friedmann Models . . . . . R. Kantowski 89

The Locally Isotropic Solutions of the Liouville and Poisson Equations
Jürgen Ehlers and William Rienstra 105

Overstability of Thin Stellar Systems . . . . . William H. Julian 117

The Age of the Galaxy from the Decay of Uranium . . . . . R. H. Dicke 123

The Effect of the Brans-Dicke Cosmology on Solar Evolution and Neutrino Fluxes . . . . . G. Shaviv and J. N. Bahcall 135

Adiabatic Fluid Spheres in General Relativity. II. Massive Configurations of Ideal Gas and Radiation . . . . . Robert F. Tooper 145

Non-radial Pulsation of General-Relativistic Stellar Models. II. Properties of the Gravitational Waves . . . . . Richard Price and Kip S. Thorne 163

Nuclear Reaction Rates at High Densities .
E. E. Salpeter and H. M. Van Horn 183

Models for Carbon-Rich Stars . . . . . G. Beaudet and E. E. Salpeter 203

Late Phases of Stellar Evolution. I. Pure Iron Stars
M. P. Savedoff, H. M. Van Horn, and S. C. Vila 221

Pulsational Instabilities in Hydrogen-Poor Massive Blue Stars. I
Norman R. Simon and Richard Stothers 247

Slowly Rotating Convective Models with Radiation Pressure
I. J. Sackmann and S. P. S. Anand 257

On the Albedo Problem for a Finite Plane-parallel Rayleigh-Scattering Atmosphere . . . . . P. S. Shieh and C. E. Siewert 265

Theoretical Line Intensities. VII. Wavelength and Depth Dependence of Line-Blanketing Effects for Pure Absorption and Non-coherent Scattering
R. Grant Athay and A. Skumanich 273

The Topology of an Axisymmetric Magnetic Field of a Differentially Rotating Sun . . . . . Y. Nakagawa and P. Swarztrauber 295

Collisionless Heating of the Solar-Wind Plasma. II. Application of the Theory of Plasma Heating by Hydromagnetic Waves . . . . . Aaron Barnes 311

Measurement of the Abundance of CO_2 in the Martian Atmosphere
N. P. Carleton, A. Sharma, R. M. Goody, W. L. Liller, and F. L. Roesler 323

Thermal Models of Jupiter and Saturn . . . . . W. B. Hubbard 333

The Fourth Positive System of Carbon Monoxide Observed in Absorption at High Resolution in the Vacuum Ultraviolet Region
J. D. Simmons, Arnold M. Bass, and S. G. Tilford 345

NOTES

The [O III] Temperature for One "Filament" in the Cygnus Loop
Robert A. R. Parker 359

The Effect of Lyman-Alpha Wing Opacity on the Temperature Scale and Helium Content for Subdwarfs . . . . . S. E. Strom and K. M. Strom 363

The Occulting Disk of the Sun at Radio Wavelengths
R. N. Bracewell, V. R. Eshleman, and Joseph V. Hollweg 367

ABSTRACTS OF ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES

K-Line Photometry of A Stars . . . . . Richard C. Henry 369

H II Regions in Twenty Nearby Galaxies . . . . . Paul W. Hodge 369

NUMBER 2

Editorial . . . . . S. Chandrasekhar 371

On the Determination of the Slope from Radio-Source Counts . . Sjur Refsdal 373

Cosmologies of Bianchi Type I with a Uniform Magnetic Field
Kenneth C. Jacobs 379

Origin of the Angular Momentum of Galaxies . . . . . P. J. E. Peebles 393

The Galaxy M82. I. Analysis of the Observations . . . . . Alan B. Solinger 403

The Radial Distribution of H II Regions in Spiral Galaxies . Paul W. Hodge 417

Production of Cosmic Gamma Rays by Compton Scattering in Discrete Sources
G. H. Rieke and T. C. Weekes 429

THE OLD GALACTIC CLUSTER NGC 3680 . . . . . O. J. Eggen 439

STUDIES OF EXTREMELY YOUNG CLUSTERS. V. STARS IN THE VICINITY OF THE ORION NEBULA . . . . . Merle F. Walker 447

A SURVEY OF HIGH-FREQUENCY RADIO RADIATION FROM PLANETARY NEBULAE
May A. Kaftan-Kassim 469

REDDENING CURVES FOR PLANETARY NEBULAE
Judith L. Pipher and Yervant Terzian 475

PASCHEN-LINE OBSERVATIONS OF THE ORION NEBULA
Michael W. Werner, Judith L. Pipher, Yervant Terzian, and J. R. Houck 485

NEUTRINO EMISSION AND THE ONSET OF CARBON BURNING . . William K. Rose 491

THE RATE OF THE PROTON-PROTON REACTION AND SOME RELATED REACTIONS
John N. Bahcall and Robert M. May 501

THE ^{7}Be ELECTRON-CAPTURE RATE . . . John N. Bahcall and Charles P. Moeller 511

THE EMISSION LINES IN THE ULTRAVIOLET SPECTRUM OF BOSS 1985
Jean Pierre Swings 515

ABUNDANCES IN TWO HORIZONTAL-BRANCH A STARS
K. Kodaira, Jesse L. Greenstein, and J. B. Oke 525

THE CHEMICAL COMPOSITION OF THE LAMBDA BOOTIS STARS
Bodo Baschek and Leonard Searle 537

ON SOLUTIONS OF AN EQUATION OF TRANSFER FOR A PLANETARY ATMOSPHERE
S. A. Mourad and C. E. Siewert 555

RADIATIVE TRANSFER BY DOUBLING VERY THIN LAYERS . . . James E. Hansen 565

COMPARISON OF SOME RECENTLY PROPOSED EXCITATION AND IONIZATION RATES
Douglas H. Sampson 575

COSMIC-RAY DEUTERIUM AND HELIUM-3 OF SECONDARY ORIGIN AND THE RESIDUAL MODULATION OF COSMIC RAYS . . . Reuven Ramaty and Richard E. Lingenfelter 587

ENERGY SPECTRA AND ABUNDANCES OF THE COSMIC-RAY NUCLEI HELIUM TO IRON FROM THE OGO-I SATELLITE EXPERIMENT
G. M. Comstock, C. Y. Fan, and J. A. Simpson 609

PROPAGATION AND SOURCE CHARACTERISTICS DERIVED FROM THE LOW-ENERGY, MULTIPLY CHARGED, COSMIC-RAY NUCLEI . . . . . G. M. Comstock 619

INTERPLANETARY SCINTILLATIONS. IV. OBSERVATIONS NEAR THE SUN
M. H. Cohen and E. J. Gundermann 645

THE MEASUREMENT OF CHROMOSPHERIC HEIGHTS . . . Walter E. Mitchell, Jr. 665

ABSORPTION SPECTRA OF Zn I, Cd I, AND Hg I IN THE VACUUM ULTRAVIOLET
W. R. S. Garton and J. P. Connerade 667

HARTREE-FOCK CALCULATIONS OF CORONAL FORBIDDEN LINES IN THE ARGON I ISOELECTRONIC SEQUENCE . . . . . William J. Wagner and Lewis L. House 677

DYNAMICAL FRICTION IN THE POST-NEWTONIAN APPROXIMATION OF GENERAL RELATIVITY . . . . . Edward P. Lee 687

NOTES

Solutions to the Vlasov Equation for Newtonian Cosmologies
Raymond C. Mjolsness 697

Motions of the Bright F-Type Stars . . . . . O. J. Eggen 701

The Central Intensities of Fraunhofer Lines near Solar Minimum
Walter E. Mitchell, Jr. 709

Escape Rate of Hydrogen from a Carbon Dioxide Atmosphere
Joseph W. Chamberlain 711

On the Solution of the Transfer Equation for Continuum Radiation in Inhomogeneous Atmospheres . . . . . P. R. Wilson 715

ABSTRACTS OF ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES

East-West Linear Polarization Distributions of Radio Galaxies at 1418 MHz
G. A. Seielstad and K. W. Weiler 719

Model Atmospheres for Yellow Supergiants . . . . Sidney B. Parsons 719

NUMBER 3

On the Spiral Structure of Disk Galaxies. III. Comparison with Observations
C. C. Lin, C. Yuan, and Frank H. Shu 721

Dynamics of the Bending of the Galaxy . . . C. Hunter and Alar Toomre 747

Stochastic Aspects of Magnetic Lines of Force with Application to Cosmic-Ray Propagation . . . . . J. R. Jokipii and E. N. Parker 777

Cosmic-Ray Life and the Stochastic Nature of the Galactic Magnetic Field
J. R. Jokipii and E. N. Parker 799

Polarized Brightness Distributions of Supernova Remnants IC 443 and W44 at 6-cm Wavelength . . . . . M. R. Kundu and T. Velusamy 807

Positions and Stokes Parameters of Seven OH-Emission Sources
Ernst Raimond and Baldur Eliasson 817

Low-Frequency Absorption due to IC 1805 and IC 1848 . . . R. S. Roger 831

Abundances in Diffuse Nebulae . . . . . Robert H. Rubin 841

Spectrophotometric Studies of Gaseous Nebulae. XII. The Symmetrical Planetary IC 3568
Paul Lee, Lawrence H. Aller, S. J. Czyzak, and Rhonda N. Duvall 853

Effects of Self-Absorption and Internal Dust on Hydrogen-Line Intensities in Gaseous Nebulae . . . . . Donald P. Cox and William G. Mathews 859

Star Formation in interstellar Clouds: Studies with a Modified Virial Theorem
Thomas Arny 871

Far-Ultraviolet Spectra of Zeta Puppis and γ^2 Velorum
Donald C. Morton, Edward B. Jenkins, and Neil H. Brooks 875

Rocket Measurement of Ultraviolet Spectra of Venus and Jupiter between 1200 and 1800 Å . . . H. Warren Moos, William G. Fastie, and M. Bottema 887

SIX-COLOR PHOTOMETRY OF STARS. XII. COLORS OF HYADES AND SUBDWARF STARS
R. L. Sears and A. E. Whitford 899

ON THE NATURE OF FAINT BLUE OBJECTS IN HIGH GALACTIC LATITUDES. II. SUMMARY OF PHOTOMETRIC RESULTS FOR 301 OBJECTS IN SEVEN SURVEY FIELDS
Allan Sandage and Willem J. Luyten 913

ULTRASHORT-PERIOD STELLAR OSCILLATIONS. III. POWER-SPECTRUM ANALYSIS OF PHOTOMETRIC OBSERVATIONS OF WHITE DWARFS
James E. Hesser, Jeremiah P. Ostriker, and George M. Lawrence 919

RED SUPERGIANTS AND NEUTRINO EMISSION . . . . . Richard Stothers 935

STUDIES IN STELLAR EVOLUTION. VII. SOLAR MODELS
S. Torres-Peimbert, E. Simpson, and R. K. Ulrich 957

ON THE CHEMICAL COMPOSITION AND AGE OF NGC 188
Pierre Demarque and Barry M. Schlesinger 965

ON THE INTERPRETATION OF THE COLOR-MAGNITUDE DIAGRAMS OF M67 AND NGC 188
Morris L. Aizenman, Pierre Demarque, and R. H. Miller 973

ON THE OSCILLATIONS AND STABILITY OF ROTATING STELLAR MODELS. II. RAPIDLY ROTATING WHITE DWARFS . . . Jeremiah P. Ostriker and Jean Louis Tassoul 987

THE POST-NEWTONIAN EQUATIONS OF HYDRODYNAMICS IN THE BRANS-DICKE THEORY
Yavuz Nutku 999

THE CORONAL BRIGHTNESS AT 2.23 MICRONS . . . . . Alan W. Peterson 1009

OBSERVATIONS OF THE TOTAL LUNAR ECLIPSE OF OCTOBER 18, 1967, AT A WAVELENGTH OF 3.33 MILLIMETERS
W. V. T. Rusch, S. D. Slobin, C. T. Stelzried, and T. Sato 1017

THE COMA CLUSTER AS A SPHERICAL INHOMOGENEITY IN RELATIVISTIC DUST
Ronald Kantowski 1023

THE LOG N–LOG S RELATION AND LUMINOSITY FUNCTIONS FOR RADIO SOURCES IN FRIEDMANN UNIVERSES . . . . . Vahé Petrosian 1029

THE SCREENING OF DISTANT OBJECTS IN UNIVERSES WITH POSITIVE COSMOLOGICAL CONSTANT . . . . . R. C. Roeder and R. T. Verreault 1047

THE RADIO NEBULA NRAO 591/593 . . . . . V. A. Hughes and R. Butler 1061

SOME MODELS OF THE EMISSION-LINE REGION OF 3C 273
John N. Bahcall and Ben-Zion Kozlovsky 1077

THE STRUCTURE OF QUASI-STELLAR RADIO SOURCES . . . . . David E. Hogg 1099

NOTES

ON THE OPTICAL POLARIZATION OF THREE QUASI-STELLAR OBJECTS William Liller 1113

ON CONTINUUM ABSORPTION BY HEAVY ELEMENTS IN HIGH-EXCITATION PLANETARY NEBULAE . . . . . J. Patrick Harrington 1117

FLARE STARS IN THE COAL SACK . . . . . N. Sanduleak 1121

A SPECTRAL MEASUREMENT OF SIMULATED METEORS
E. Tagliaferri and J. C. Slattery 1123

On the Equation of Radiative Transfer in a Magnetoactive Plasma
V. V. Zheleznyakov 1129

ABSTRACTS OF ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES

An Investigation of Short-Period Variable Stars. I. The Delta Scuti Stars; II. The AI Velorum Stars . . . . . M. S. Bessell 1133

ANNOUNCEMENTS 1135

INDEX TO VOLUME 155, PART 1 1137

THE ASTROPHYSICAL JOURNAL

FOUNDED IN 1895 BY GEORGE E. HALE AND JAMES E. KEELER

Published in Collaboration with the American Astronomical Society

S. CHANDRASEKHAR
Managing Editor
University of Chicago

EDITORIAL BOARD

MAARTEN SCHMIDT (1969-73)
California Institute of Technology

DONALD E. OSTERBROCK (1967-71)
Washburn Observatory

L. WOLTJER (1968-72)
Columbia University

GEORGE W. PRESTON (1966-70)
Mount Wilson and Palomar Observatories

EDWIN E. SALPETER (1965-69)
Cornell University

Editorial Assistant: JEANETTE R. BURNETT

VOLUME 155, PART 2

JANUARY–MARCH 1969

THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS

COPYRIGHT 1969
BY THE UNIVERSITY OF CHICAGO
PUBLISHED MONTHLY

COMPOSED AND PRINTED BY THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS, U.S.A.

CONTENTS, PART 2

NUMBER 1

AN EXTREMELY RED STAR IN THE REGION OF THE YOUNG OPEN CLUSTER NGC 6231
Wilhelm Seggewiss L1

CIRCUMSTELLAR INFRARED EMISSION FROM TWO PECULIAR OBJECTS—R AQUARII AND R CORONAE BOREALIS
Wayne A. Stein, John E. Gaustad, F. C. Gillett, and R. F. Knacke L3

FAR-INFRARED OBSERVATION OF THE GALACTIC-CENTER REGION AT 100 MICRONS
William F. Hoffmann and Carl L. Frederick L9

CHANGES IN POLARIZATION OF THE R CORONAE BOREALIS STAR RY SAGITTARII
K. Serkowski and A. Kruszewski L15

PROBABLE DETECTION OF INTERSTELLAR $C^{13}H^+$. V. J. Bortolot, Jr., and P. Thaddeus L17

A SURVEY OF DUST CLOUDS FOR OH EMISSION . . D. D. Cudaback and C. Heiles L21

POSSIBLE TIME VARIATION OF THE RADIO EMISSION FROM SCO X-1 . . J. G. Ables L27

SEARCH FOR GAMMA RADIATION FROM CENTAURUS A
R. C. Haymes, D. V. Ellis, G. J. Fishman, S. W. Glenn, and J. D. Kurfess L31

ASTROPHYSICAL CONSEQUENCES OF DIRAC'S HYPOTHESIS OF A VARIABLE GRAVITATIONAL NUMBER . . . . . H. Dehnen and H. Hönl L35

ABSORPTION REDSHIFTS IN THE QUASI-STELLAR OBJECTS PHL 5200 AND B194
E. Margaret Burbidge L43

PHOTOMETRIC SELECTION OF QUASI-STELLAR OBJECTS . . K. Janes and R. Lynds L47

A RADIO OBSERVATIONAL TEST FOR LOW-ENERGY COSMIC RAYS IN THE GALAXY
D. W. Greenberg L51

NUMBER 2

FINE-STRUCTURE TRANSITIONS AND THE BACKGROUND MICROWAVE RADIATION
Vahé Petrosian, John N. Bahcall, and E. E. Salpeter L57

WATER-VAPOR CLOUDS IN THE INTERSTELLAR MEDIUM
Lewis E. Snyder and David Buhl L65

THE SPECTRA OF OPAQUE RADIO SOURCES K. I. Kellermann and I. I. K. Pauliny-Toth L71

DISCOVERY OF AN INTENSE OH EMISSION SOURCE . . B. Eliasson and J. F. Bartlett L79

THE OCCULTATION POSITION OF AN OH EMISSION SOURCE IN W24
David D. Cudaback and William J. Welch L83

THE FLUX DENSITY OF TAURUS A AT 4.3-MM WAVELENGTH
R. W. Hobbs, H. H. Corbett, and N. J. Santini L87

NARROW-BAND PHOTOMETRY OF FIVE COMBINATION-VARIABLE STARS AND THE X-RAY SOURCE CYG X-2 . . . . . H. M. Johnson and J. C. Golson L91

Detection of the 12.8-Micron Ne^+ Emission Line from the Planetary Nebula IC 418 . . . . . F. C. Gillett and W. A. Stein L97

Central Convection and Solar Neutrinos . . . . . Icko Iben, Jr. L101

Possible Conversion of Rotational Energy of the Neutron Star in the Crab Nebula into Energy of Relativistic Electrons . . A. Finzi and R. A. Wolf L107

On the Nature of Ryle and Bailey's Candidate Star for the Pulsating Radio Source CP 1919
J. A. Westphal, Jerome Kristian, Grant Snellen, Allan Sandage, Maarten Schmidt, J. B. Oke, Gerry Neugebauer, and E. E. Becklin L109

Solar C II Resonance-Line Profiles . Richard A. Berger and Elmo C. Bruner, Jr. L115

Sixteen-Second Periodic Pulsations Observed in the Correlated Microwave and Energetic X-Ray Emission from a Solar Flare
G. K. Parks and J. R. Winckler L117

Optical Identification and Observations of the Pulsar NP 0532
R. Lynds, S. P. Maran, and D. E. Trumbo L121

Erratum

Radio and Optical Observations of the Hercules Cluster of Galaxies
T. D. Carr, G. C. Omer, Jr., G. R. Lebo, and R. W. Davis L127

NUMBER 3

A Comparison of the Nuclei in M51 and NGC 4151 . . Daniel W. Weedman L129

The Continuum of BL Lac . . . . . N. Visvanathan L133

Numerology and Local Quasi-stellar Objects . . . . . Barry J. Smernoff L139

Spectroscopy of a New, Faint Quasi-stellar Object . . . . Alan Stockton L141

Detection of X-Rays from the Large Magellanic Cloud
Hans Mark, R. Price, R. Rodrigues, F. D. Seward, and C. D. Swift L143

The Diffuse X-Radiation Spectrum below 4 keV
A. J. Baxter, B. G. Wilson, and D. W. Green L145

Cosmic-Ray Heating of the Interstellar Gas
G. B. Field, D. W. Goldsmith, and H. J. Habing L149

Magnetic Fields in Interstellar Neutral-Hydrogen Clouds . G. L. Verschuur L155

Further Spectroscopic Observations of the Optical Object Identified with X-Ray Source Cygnus X-2 . . . . Robert P. Kraft and Joseph S. Miller L159

An Upper Limit to the Abundance of He^3 in Messier 17
T. V. Seling and C. Heiles L163

Stellar Li/Be and Li^6/Li^7 Ratios . . . . . Peter S. Conti L167

Microscale Fluctuations in the Interplanetary Magnetic Field
L. F. Burlaga, K. W. Ogilvie, and D. H. Fairfield L171

The Spectrum of NML Cygnus from 7.5 to 14 Microns
Wayne A. Stein, John E. Gaustad, F. C. Gillett, and R. F. Knacke L177

CIRCUMSTELLAR INFRARED EMISSION FROM COOL STARS N. J. Woolf and E. P. Ney L181

ON THE COMPOSITION OF CIRCUMSTELLAR GRAINS . . . . . Robert C. Gilman L185

A POSSIBLE IDENTIFICATION OF INTERSTELLAR SILICATE ABSORPTION IN THE INFRARED SPECTRUM OF 119 TAURI
R. F. Knacke, J. E. Gaustad, F. C. Gillett, and W. A. Stein L189

THE INFRARED SOURCES IN THE TRAPEZIUM REGION OF M42
E. P. Ney and D. A. Allen L193

SPECTRAL DISTRIBUTION OF INFRARED RADIATION FROM THE TRAPEZIUM REGION OF THE ORION NEBULA . . . . . Wayne A. Stein and F. C. Gillett L197

INDEX TO VOLUME 155, PART 2 . . . . . L201

INDEX TO VOLUME 156, PART 1

Absolute *gf*-Values for Fe I and Fe II Lines (Grasdalen, Huber, and Parkinson), 1153.

Abt, Helmut A., and Jewsbury, Clifford P. Rotational Velocities in the Open Cluster NGC 6475 (M7), 983.

Activity in the Crab Nebula (Scargle), 401.

Alcaino, Gonzalo. The Globular Clusters NGC 2808 and NGC 1851, 853.

α^2 Canum Venaticorum and the Oblique-Rotator Theory (Pyper), 796.

Asymptotic Form for Synchrotron Spectra below Razin Cutoff (Simon), 341.

Athay, R. Grant, and Canfield, Richard C. Computed Profiles for Solar Mg b- and Na D-Lines, 695.

Auer, L. H., and Mihalas, Dimitri. Non-LTE Model Atmospheres. I. Radiative Equilibrium Models with Lyman-Alpha, 157.

Auer, L. H., and Mihalas, Dimitri. Non-LTE Model Atmospheres. II. Effects of Balmer α, 681.

Bahcall, John N., Bahcall, Neta A., and Ulrich, Roger K. Sensitivity of the Solar-Neutrino Fluxes, 559.

Bahcall, Neta A. *See* Bahcall, Bahcall, and Ulrich.

Barnothy, J. M. The Hoyle-Fowler Model of Quasi-stellar Objects, 373.

Basu, B. Photoelectric Observations of ET Pegasi, 785.

Belton, M. J. S., and Hunten, D. M. A Search for O_2 on Mars and Venus: A Possible Detection of Oxygen in the Atmosphere of Mars, 797.

Bengtson, Roger D. *See* Miller and Bengtson.

Berge, G. L., and Greisen, E. W. High-Resolution Interferometry of Venus at 3.12-cm Wavelength, 1125.

Billings, D. E. *See* Boardman and Billings.

Billings, Donald E., and Joselyn, Jo Ann. Physical Properties of λ5303 Coronal Emission Regions, 739.

Binary Stars among Cataclysmic Variables. X. Photoelectric Observations of EM Cygni (Mumford and Krzeminski), 1185.

Blue Horizontal-Branch Stars of NGC 6397 (Newell, Rodgers, and Searle), 597.

Boardman, W. J., and Billings, D. E. A Coronal Enhancement in the Extreme Ultraviolet, 731.

Boldt, Elihu A., Desai, Upendra D., and Holt, Stephen S. 2–20 keV Spectrum of X-Rays from the Crab Nebula and the Diffuse Background near Galactic Anticenter, 427.

Bologna, J. M., McClain, E. F., and Sloanaker, R. M. Polarization of Discrete Sources at 21.2–cm Wavelength, and Galactic Depolarization, 815.

Bradley, Philip T., and Morton, Donald C. Model Atmospheres for O-Type Stars with Ultraviolet Line Blanketing, 687.

Brandt, John C., Wolff, Charles, and Cassinelli, Joseph P. Interplanetary Gas. XVI. A Calculation of the Angular Momentum of the Solar Wind, 1117.

Browne, J. C. Electronic Transition Moments for the Lyman Band of H_2, 397.

Burbidge, G. R. *See* Wolfe and Burbidge.

Canfield, Richard C. *See* Athay and Canfield.

Cassinelli, Joseph P. *See* Brandt, Wolff, and Cassinelli.

Cesarsky, Catherine J. Effect of Line Absorption on Main-Sequence Model Stars, 385.

Chan, Y. W. Tung. *See* Demoulin and Chan.

Chapman, Robert D. Oscillator Strengths and Wavelengths of Some X-Ray and Extreme-Ultraviolet Spectrum Lines of Highly Ionized Iron, 87.

Chromospheres and Polarization in Late-Type Stars (Dyck and Johnson), 389.

Clement, Maurice J. Differential Rotation in Stars on the Upper Main Sequence, 1051.

Cohen, Judith G., Deutsch, Armin, J., and Greenstein, Jesse L. The Spectrum of α^2 Canum Venaticorum, 5000–67000 Å, 629.

Comparison of the Reflectivity and Color of Bright and Dark Regions of the Surface of Mars (McCord), 79.

Computed Profiles for Solar Mg b- and Na D-Lines (Athay and Canfield), 695.

Conditions for Microwave Radiation from Excited OH Λ-Doublet States (Litvak, Zuckerman, and Dickinson), 875.

Conti, Peter S. Zeeman Observations of Metallic-Line Stars, 661.

Coronal Enhancement in the Extreme Ultraviolet (Boardman and Billings), 731.

Criterion for Nuclear-energized Pulsational Instability (Simon and Stothers), 377.

Curve-of-Growth Analysis for the Close Binary HR 5317 (Kondo and McCluskey), 1007.

Davis, Leverett, Jr. *See* Jokipii and Davis.

Delcroix, A., and Lemaire, A. Transport Coefficients in the Chromosphere and Coronal Gas. II. Thermal Conductivity, 787.

Demoulin, Marie-Helene. The Peculiar Galaxy NGC 4194, 325.

Demoulin, Marie-Helene, and Chan, Y. W. Tung. Rotation and Mass of the Galaxy NGC 6574, 501.

Desai, Upendra D. *See* Boldt, Desai, and Holt.

Determinations of Helium Abundance from Radiofrequency Recombination Lines (Palmer, Zuckerman, Penfield, Lilley, and Mezger).

Deutsch, A. J., Wilson, O. C., and Keenan, P. C. High-Dispersion Classification of K2–M6 Giants of High and Low Velocity, 107.

Deutsch, Armin J. *See* Cohen, Deutsch, and Greenstein.

Dickinson, D. F. *See* Litvak, Zuckerman, and Dickinson.

Diesendorf, M. O., and Ninham, B. W. The Effect of Quantum Correlations on Electron-Scattering Opacities, 1069.

Differential Rotation in Stars on the Upper Main Sequence (Clement), 1051.

Discrete Source Models to Explain the Microwave Background Radiation (Wolfe and Burbidge), 345.

Dissociation of Molecules by the Absorption of Line Radiation (Werner), 753.

Distance of the Hyades and the Mass-Luminosity Relation (Eggen), 241.

Distribution of H II Regions in Irregular Galaxies (Hodge), 847.

Dyck, H. Melvin, and Johnson, Hollis R. Chromospheres and Polarization in Late-Type Stars, 389.

Dynamical Models of Novae (Sparks), 569.

Dyson, Freeman J. Seismic Response of the Earth to a Gravitational Wave in the 1-Hz Band, 529.

Effect of Line Absorption on Main-Sequence Model Stars (Cesarsky), 385.
Effect of Quantum Correlations of Electron-Scattering Opacities (Diesendorf and Ninham), 1069.
Effect of Wave-Particle Interactions on the Propagation of Cosmic Rays (Kulsrud and Pearce), 445.
Eggen, O. J. The Distance of the Hyades and the Mass-Luminosity Relation, 241.
Eggen, Olin J. Faint Cepheids in Cygnus and Monoceros, 617.
Electronic Transition Moments for the Lyman Band of H_2 (Browne), 397.
Evolution of Initially Pure ^{12}C Stars and the Production of Planetary Nebulae (Kutter and Savedoff), 1021.
Exterior Solution for Radiating Spheres with Zero Limb Darkening in General Relativity (Kaufmann), 257.

Faint Cepheids in Cygnus and Monoceros (Eggen), 617.
Further Photometry of EX Hydrae (Mumford), 125.

Galactic H II Regions. IV. 1.95-cm Observations with High Angular Resolution and High Positional Accuracy (Schraml and Mezger), 269.
General Solution of the b_n Problem for Gaseous Nebulae (Sejnowski and Hjellming), 915.
Globular Clusters NGC 2808 and NGC 1851 (Alcaino), 853.
Goldreich, Peter, and Lynden-Bell, Donald. Io, a Jovian Unipolar Inductor, 59.
Gorenstein, P., Kellogg, E. M., and Gursky, H. The Spectrum of Diffuse Cosmic X-Rays, 1–13 keV, 315.
Grasdalen, Gary L., Huber, Martin, and Parkinson, W. H. Absolute *gf*-Values for Fe I and Fe II Lines, 1153.
Greenstein, Jesse L. *See* Cohen, Deutsch, and Greenstein.
Greisen, E. W. *See* Berge and Greisen.
Gursky, H. *See* Gorenstein, Kellogg, and Gursky.

Hall, David L. *See* Matsushima and Hall.
Harrington, J. Patrick. Ionization Stratification and Chemical Abundances in the Planetary Nebula NGC 7662, 903.
Heiles, Carl. Neutral Hydrogen in Dark Dust Clouds, 493.
Henyey, Louis, and L'Ecuyer, J. Studies in Stellar Evolution. VIII. The Time Scale for the Diffusion of Energy in the Stellar Interior, 549.
High-Dispersion Classification of K2–M6 Giants of High and Low Velocity (Deutsch, Wilson, and Keenan), 107.
High-Resolution Interferometry of Venus at 3.12-cm Wavelength (Berge and Greisen), 1125.
High-Velocity Cloud Complexes as Extragalactic Objects in the Local Group (Verschuur), 771.
Hiltner, W. A. *See* Schild, Hiltner, and Sanduleak.
Hjellming, Robert M. *See* Sejnowski and Hjellming.
Hodge, Paul W. Distribution of H II Regions in Irregular Galaxies, 847.
Holt, Stephen S. *See* Boldt, Desai, and Holt.
Howe, M. S. On Gravity-coupled Magnetohydrodynamic Waves in the Sun's Atmosphere, 27.
Hoyle-Fowler Model of Quasi-stellar Objects (Barnothy), 373.
Hubbard, W. B., and Lampe, Martin. Thermal Conduction by Electrons in Stellar Matter, 795.

Huber, Martin. *See* Grasdalen, Huber, and Parkinson.
Hunten, D. M. *See* Belton and Hunten.

Infrared Pumping of Interstellar OH (Litvak), 471.
Interaction of X-Ray Sources with Optically Thick Environments (Tarter and Salpeter), 953.
Interaction of X-Ray Sources with Optically Thin Environments (Tarter, Tucker, and Salpeter), 943.
Intergalactic H I Emission at 21 Centimeters (Penzias and Wilson), 799.
Interplanetary Gas. XVI. A Calculation of the Angular Momentum of the Solar Wind (Brandt, Wolff, and Cassinelli), 1117.
Io, a Jovian Unipolar Inductor (Goldreich and Lynden-Bell), 59.
Ionization Stratification and Chemical Abundances in the Planetary Nebula NGC 7662 (Harrington), 903.
Ipser, James R. Relativistic, Spherically Symmetric Star Clusters. II. Sufficient Conditions for Stability against Radial Perturbations, 509.

Jewsbury, Clifford P. *See* Abt and Jewsbury.
Johnson, Hollis R. *See* Dyck and Johnson.
Jokipii, J. R. Stochastic Variations of Cosmic Rays in the Solar System, 1107.
Jokipii, J. R., and Davis, Leverett, Jr. Long-Wavelength Turbulence and the Heating of the Solar Wind, 1101.
Jordan, Carole. Relative Intensities of Selected Si II Multiplets in the Spectrum of the Sun and ZETA, 49.
Joselyn, Jo Ann. *See* Billings and Joselyn.

Kaufmann, Pierre, Matsuura, Oscar T., and Santos, P. Marques dos. On the Possible Emission of Polarized Microwave Radiation from the Solar Hemispheres, 43.
Kaufmann, William J., III. The Exterior Solution for Radiating Spheres with Zero Limb Darkening in General Relativity, 257.
Keenan, P. C. *See* Deutsch, Wilson, and Keenan.
Kellogg, E. M. *See* Gorenstein, Kellogg, and Gursky.
Koch, Robert H. *See* Snowden and Koch.
Kondo, Yoji, and McCluskey, George E., Jr. Curve-of-Growth Analysis for the Close Binary HR 5317, 1007.
Kristian, Jerome. *See* Sandage, Westphal, and Kristian.
Krzeminski, W. *See* Mumford and Krzeminski.
Kulsrud, Russell, and Pearce, William P. The Effect of Wave-Particle Interactions on the Propagation of Cosmic Rays, 445.
Kurucz, Robert L. A Matrix Method for Calculating the Source Function, Mean Intensity, and Flux in a Model Atmosphere, 235.
Kutter, G. S., and Savedoff, M. P. Evolution of Initially Pure ^{12}C Stars and the Production of Planetary Nebulae, 1021.

Lampe, Martin. *See* Hubbard and Lampe.
L'Ecuyer, J. *See* Henyey and L'Ecuyer.
Leibowitz, Elia M. Polarization of the Continuum Background in Planetary Nebulae, 261.
Leighton, Robert B. A Magneto-Kinematic Model of the Solar Cycle, 1.

Lemaire, A. *See* Delcroix and Lemaire.

Lilley, A. E. *See* Palmer, Zuckerman, Penfield, Lilley and Mezger.

Lin, C. C., Yuan, C., and Shu, Frank H. On the Spiral Structure of Disk Galaxies. III. Comparison with Observations, 797.

Linsky, Jeffrey L. On the Pressure-induced Opacity of Molecular Hydrogen in Late-Type Stars, 989.

Litvak, M. M. Infrared Pumping of Interstellar OH, 471.

Litvak, M. M., Zuckerman, B., and Dickinson, D. F. Conditions for Microwave Radiation from Excited OH Λ-Doublet States, 875.

Long-Wavelength Turbulence and the Heating of the Solar Wind (Jokipii and Davis), 1101.

Luke, S. K. The Radio-Frequency Spectrum of H_2^+, 761.

Lynden-Bell, Donald. *See* Goldreich and Lynden-Bell.

McClain, E. F. *See* Bologna, McClain, and Sloanaker.

McCluskey, George E., Jr. *See* Kondo and McCluskey.

McCord, Thomas B. Comparison of the Reflectivity and Color of Bright and Dark Regions on the Surface of Mars, 79.

McCray, Richard. Synchrotron Radiation Losses in Self-absorbed Radio Sources, 329.

Magnetic Field of HD 215441 (Preston), 967.

Magnetic Field and Light Variations of 17 Comae Berenices and κ Cancri (Preston, Stepien, and Wolff), 653.

Magneto-kinematic Model of the Solar Cycle (Leighton), 1.

Marlborough, J. M. Models for the Envelopes of Be Stars, 135.

Matrix Method for Calculating the Source Function, Mean Intensity, and Flux in a Model Atmosphere (Kurucz), 235.

Matsushima, Satoshi. *See* Terashita and Matsushima.

Matsushima, Satoshi, and Hall, David L. On the Theoretical $(U - B)$- and $(B - V)$-Colors, 779.

Matsushima, Satoshi, and Terashita, Yoichi. Radiative Opacity in Stellar Atmospheres. III. Effect of the Hydrogen-to-Helium Ratio on the Atmospheric Structure, 183.

Matsushima, Satoshi, and Terashita, Yoichi. The Structure of White-Dwarf Atmospheres. III. The Atmosphere of 40 Eridani B, 219.

Matsuura, Oscar T. *See* Kaufmann, Matsuura, and Santos.

May, T. C., and Waddington, C. J. A Search for Energetic Gamma-Ray Emission from the Supernova Remnant Cassiopeia A, 437.

Measurements of Magnetic Fields in Interstellar Clouds of Neutral Hydrogen (Verschuur), 861.

Menzel, Donald H. Oscillator Strengths, f, for High-Level Transitions in Hydrogen, 399.

Mezger, P. G. *See* Palmer, Zuckerman, Penfield, Lilley, and Mezger.

Mezger, P. G. *See* Schraml and Mezger.

Mihalas, Dimitri. *See* Auer and Mihalas.

Miller, Myron H., and Bengtson, Roger D. Relative Transition Probabilities for Silicon, 393.

Mitchell, Walter E., Jr. and Mohler, Orren C. Revision of the Ultraviolet Solar Spectrum 3650–3000 Å, 1185.

Model Atmospheres for O-Type Stars with Ultraviolet Line Blanketing (Bradley and Morton), 687.

Model Atmospheres for RR Lyrae Stars (Strom), 177.

Models for the Envelopes of Be Stars (Marlborough), 135.

Mohler, Orren C. *See* Mitchell and Mohler.

Morris, S. C. *See* Walker, Morris, and Younger.

Morton, Donald C. *See* Bradley and Morton.

Mumford, George S. Further Photometry of EX Hydrae, 125.

Mumford, George S., and Krzeminski, W. Binary Stars among Cataclysmic Variables. X. Photoelectric Observations of EM Cygni, 1185.

Nature of the Variability of HD 19216 (Preston), 1175.

Neutral Hydrogen in Dark Dust Clouds (Heiles), 493.

Newell, E. B., Rodgers, A. W., and Searle, Leonard. The Blue Horizontal-Branch Stars of NGC 6397, 597.

Ninham, B. W. *See* Diesendorf and Ninham.

Noerdlinger, Peter D. Quasi-stellar Objects and the Density of Intergalactic Hydrogen, 841.

Non-LTE Model Atmospheres. I. Radiative Equilibrium Models with Lyman-Alpha (Auer and Mihalas), 157.

Non-LTE Model Atmospheres. II. Effects of Balmer α (Auer and Mihalas), 681.

O'Dell, C. R. Optical Backscattering Functions in the Pleiades, 381.

On the Equation of State of a Relativistic Fermi-Dirac Gas at High Temperatures (Tooper), 1075.

On Gravity-coupled Magnetohydrodynamic Waves in the Sun's Atmosphere (Howe), 27.

On the Possible Emission of Polarized Microwave Radiation from the Solar Hemispheres (Kaufmann, Matsuura, and Santos), 43.

On the Pressure-induced Opacity of Molecular Hydrogen in Late-Type Stars (Linsky), 989.

On the Pulsation Hypothesis for Massive Red Supergiants (Stothers), 541.

On the Theoretical $(U - B)$- and $(B - V)$-Colors (Matsushima and Hall), 779.

On the Spiral Structure of Disk Galaxies. III. Comparison with Observations (Lin, Yuan, and Shu), 797.

Optical Backscattering Functions in the Pleiades (O'Dell), 381.

Oscillator Strengths, f, for High-Level Transitions in Hydrogen (Menzel), 399.

Oscillator Strengths and Wavelengths of Some X-Ray and Extreme-Ultraviolet Spectrum Lines of Highly Ionized Iron (Chapman), 87.

Palmer, Patrick, Zuckerman, B., Penfield, H., Lilley, A. E., and Mezger, P. G. Determinations of Helium Abundance from Radiofrequency Recombination Lines, 887.

Parkinson, W. H. *See* Grasdalen, Huber, and Parkinson.

Particulate Thermophysical Model of the Lunar Soil (Winter and Saari), 1135.

Pearce, William P. *See* Kulsrud and Pearce.

Peculiar Galaxy NGC 4194 (Demoulin), 325.

Penfield, H. *See* Palmer, Zuckerman, Penfield, Lilley and Mezger.

Penzias, A. A., and Wilson, R. W. Intergalactic H I Emission at 21 Centimeters, 799.

Photoelectric Observations of ET Pegasi (Basu), 785.

Photoelectric Scanner Observations of CH Cygni for August 3, 1967 (Walker, Morris, and Younger), 117.

Physical Properties of λ5303 Coronal Emission Regions (Billings and Joselyn), 739.

Polarization of the Continuum Background in Planetary Nebulae (Leibowitz), 261.

Polarization of Discrete Sources at 21.2-cm Wavelength, and Galactic Depolarization (Bologna, McClain, and Sloanaker), 815.

Preston, George W. The Magnetic Field of HD 215441, 967.

Preston, George W. The Nature of the Variability of HD 19216, 1175.

Preston, George W., Stepien, Kazimierz, and Wolff, Sidney Carne. The Magnetic Field and Light Variations of 17 Comae Berenices and κ Cancri, 653.

Propagation and Anisotropy of Cosmic Rays. I. Theory for Steady Streaming (Wentzel), 303.

Pyper, Diane M. α^2 Canum Venaticorum and the Oblique-Rotator Theory, 796.

Quasi-stellar Objects and the Density of Intergalactic Hydrogen (Noerdlinger), 841.

Radiative Opacity in Stellar Atmospheres. III. Effect of the Hydrogen-to-Helium Ratio on the Atmospheric Structure (Matsushima and Terashita), 183.

Radio-Frequency Spectrum of H_2^+ (Luke), 761.

Relative Intensities of Selected Si II Multiplets in the Spectrum of the Sun and ZETA (Jordan), 49.

Relative Transition Probabilities for Silicon (Miller and Bengtson), 393.

Relativistic, Spherically Symmetric Star Clusters. II. Sufficient Conditions for Stability against Radial Perturbations (Ipser), 509.

Remarks on Half-Space Applications regarding an Equation of Transfer for a Planetary Atmosphere (Siewert), 1181.

Results of Five Nights of Continuous Monitoring of the Optical Flux from Sco X-1 (Sandage, Westphal, and Kristian), 927.

Revision of the Ultraviolet Solar Spectrum 3650–3000 Å (Mitchell and Mohler), 1185.

Rocket Spectrographic Observations of α Virginis (Smith), 93.

Rodgers, A. W. *See* Newell, Rodgers, and Searle.

Rotation and Mass of the Galaxy NGC 6574 (Demoulin and Chan), 501.

Rotational Velocities in the Open Cluster NGC 6475 (M7) (Abt and Jewsbury), 983.

Saari, J. M. *See* Winter and Saari.

Salpeter, Edwin E. *See* Tarter and Salpeter.

Salpeter, Edwin E. *See* Tarter, Tucker, and Salpeter.

Sandage, Allan, Westphal, J. A., and Kristian, Jerome. Results of Five Nights of Continuous Monitoring of the Optical Flux from Sco X-1, 927.

Sanduleak, N. *See* Schild, Hiltner, and Sanduleak.

Santos, P. Marques dos. *See* Kaufmann, Matsuura, and Santos.

Savage, Blair D. Thermal Generation of Hydromagnetic Waves in Sunspots, 707.

Savedoff, M. P. *See* Kutter and Savedoff.

Scargle, Jeffrey D. Activity in the Crab Nebula, 401.

Schild, Rudolph E., Hiltner, W. A., and Sanduleak, N. A Spectroscopic Study of the Association Scorpius OB 1, 609.

Schraml, J., and Mezger, P. G. Galactic H II Regions. IV. 1.95-cm Observations with High Angular Resolution and High Positional Accuracy, 269.

Search for Energetic Gamma-Ray Emission from the Supernova Remnant Cassiopeia A (May and Waddington), 437.

Search for O_2 on Mars and Venus: A Possible Detection of Oxygen in the Atmosphere of Mars (Belton and Hunten), 797.

Searle, Leonard. *See* Newell, Rodgers, and Searle.

Seismic Response of the Earth to a Gravitational Wave in the 1-Hz Band (Dyson), 529.

Sejnowski, T. J., and Hjellming, Robert M. The General Solution of the b_n Problem for Gaseous Nebulae, 915.

Sensitivity of the Solar-Neutrino Fluxes (Bahcall, Bahcall, and Ulrich), 559.

Shu, Frank H. *See* Lin, Yuan, and Shu.

Siewert, C. E. Remarks on Half-Space Applications regarding an Equation of Transfer for a Planetary Atmosphere, 1181.

Simon, M. Asymptotic Form for Synchrotron Spectra below Razin Cutoff, 341.

Simon, Norman R., and Stothers, Richard. A Criterion for Nuclear-energized Pulsational Instability, 377.

Sloanaker, R. M. *See* Bologna, McClain, and Sloanaker.

Smith, Andrew M. Rocket Spectrographic Observations of α Virginis, 93.

Smith, William Hayden. Transition Probabilities for the Swan and Mulliken C_2 Bands, 791.

Snowden, Michael S., and Koch, Robert H. Spectrographic and Photometric Analyses of HR 7484, 667.

Solar [Fe II] Lines (Withbroe), 1177.

Some Implications of the Anisotropy Measured in the Microwave Background (Wolfe), 803.

Sparks, Warren M. Dynamical Models of Novae, 569.

Spectrographic and Photometric Analyses of HR 7484 (Snowden and Koch), 667.

Spectroscopic Binaries and Collapsed Stars (Trimble and Thorne), 1013.

Spectroscopic Study of the Association Scorpius OB 1 (Schild, Hiltner, and Sanduleak), 609.

Spectrum of α^2 Canum Venaticorum, 5000–6700 Å (Cohen, Deutsch, and Greenstein), 629.

Spectrum of Diffuse Cosmic X-Rays, 1–13 keV (Gorenstein, Keilogg, and Gursky), 315.

Stepien, Kazimierz. *See* Preston, Stepien, and Wolff.

Stochastic Variations of Cosmic Rays in the Solar System (Jokipii), 1107.

Stothers, Richard. On the Pulsation Hypothesis for Massive Red Supergiants, 541.

Stothers, Richard. *See* Simon and Stothers.

Strom, S. E. Model Atmospheres for RR Lyrae Stars, 177.

Structure of White-Dwarf Atmospheres. II. Masses and Radii Determined from Atmospheric Parameters of DA Stars (Terashita and Matsushima), 203.

Structure of White-Dwarf Atmospheres. III. The Atmosphere of 40 Eridani B (Matsushima and Terashita), 219.

Studies in Stellar Evolution. VIII. The Time Scale for the Diffusion of Energy in the Stellar Interior (Henyey and L'Ecuyer), 549.

Synchrotron Radiation Losses in Self-absorbed Radio Sources (McCray), 329.

Synthesis of the Elements within Objects Exploding from Very High Temperatures (Wagoner), 795.

Tarter, C. Bruce, and Salpeter, Edwin E. The Interaction of X-Ray Sources with Optically Thick Environments, 953.

Tarter, C. Bruce, Tucker, Wallace H., and Salpeter, Edwin E. The Interaction of X-Ray Sources with Optically Thin Environments, 943.

Terashita, Yoichi. *See* Matsushima and Terashita.

Terashita, Yoichi, and Matsushima, Satoshi. The Structure of White-Dwarf Atmospheres. II. Masses and Radii Determined from Atmospheric Parameters of DA Stars, 203.

Thermal Conduction by Electrons in Stellar Matter (Hubbard and Lampe), 795.

Thermal Generation of Hydromagnetic Waves in Sunspots (Savage), 707.

Tooper, Robert F. On the Equation of State of a Relativistic Fermi-Dirac Gas at High Temperatures, 1075.

Transition Probabilities for the Swan and Mulliken C_2 Bands (Smith), 791.

Transport Coefficients in the Chromosphere and Coronal Gas. II. Thermal Conductivity (Delcroix and Lemaire), 787.

Trimble, Virginia L., and Thorne, Kip S. Spectroscopic Binaries and Collapsed Stars, 1013.

Tucker, Wallace H. *See* Tarter, Tucker, and Salpeter.

2–20 keV Spectrum of X-Rays from the Crab Nebula and the Diffuse Background near Galactic Anticenter (Boldt, Desai, and Holt), 427.

Ulrich, Roger K. *See* Bahcall, Bahcall, and Ulrich.

Verschuur, G. L. The High-Velocity Cloud Complexes as Extragalactic Objects in the Local Group, 771.

Verschuur, G. L. Measurements of Magnetic Fields in Interstellar Clouds of Neutral Hydrogen, 861.

Waddington, C. J. *See* May and Waddington.

Wagoner, Robert V. Synthesis of the Elements within Objects Exploding from Very High Temperatures, 795.

Walker, G. A. H., Morris, S. C., and Younger, P. F. Photoelectric Scanner Observations of CH Cygni for August 3, 1967, 117.

Wentzel, Donat G. The Propagation and Anisotropy of Cosmic Rays. I. Theory for Steady Streaming, 303.

Werner, Michael W. Dissociation of Molecules by the Absorption of Line Radiation, 753.

Westphal, J. A. *See* Sandage, Westphal, and Kristian.

Wilson, O. C. *See* Deutsch, Wilson, and Keenan.

Wilson, R. W. *See* Penzias and Wilson.

Winter, D. F., and Saari, J. M. A Particulate Thermophysical Model of the Lunar Soil, 1135.

Withbroe, George L. The Solar [Fe II] Lines, 1177.

Wolfe, A. M. Some Implications of the Anisotropy Measured in the Microwave Background, 803.

Wolfe, A. M., and Burbidge, G. R. Discrete Source Models to Explain the Microwave Background Radiation, 345.

Wolff, Charles. *See* Brandt, Wolff, and Cassinelli.

Wolff, Sidney Carne. *See* Preston, Stepien, and Wolff.

Younger, P. F. *See* Walker, Morris, and Younger.

Yuan, C. *See* Lin, Yuan, and Shu.

Zeeman Observations of Metallic-Line Stars (Conti), 661.

Zuckerman, B. *See* Litvak, Zuckerman, and Dickinson.

Zuckerman, B. *See* Palmer, Zuckerman, Penfield, Lilley and Mezger.

INDEX TO VOLUME 156, PART 2

Absorption Lines Produced by Galactic Halos (Bahcall and Spitzer), L63.

Albers, Henry. Infrared Surveys of the Southern Milky Way. I. Suspected Supergiant Stars, L37.

Analysis of the Slowing-down Rate of NP 0532 (Goldwire and Michel), L111.

Auer, L. H., and Mihalas, Dimitri. Brackett-Alpha Emission in Non-LTE Model Stellar Atmospheres, L151.

Bahcall, John N., Osmer, Patrick S., and Schmidt, Maarten. On the Absorption Spectrum of Ton 1530, L1.

Bahcall, John N., and Peebles, P. J. E. Statistical Tests for the Origin of Absorption Lines Observed in Quasi-stellar Sources, L7.

Bahcall, John N., and Spitzer, Lyman, Jr. Absorption Lines Produced by Galactic Halos, L63.

Barnothy, Jeno. Comments on "Astrophysical Consequences of Dirac's Hypothesis of a Variable Gravitational Number," by H. Dehnen and H. Hönl, L159.

Becklin, E. E. *See* Neugebauer, Becklin, Kristian, Leighton, Snellen, and Westphal.

Becklin, E. E. *See* Oke, Neugebauer, and Becklin.

Bergh, Sidney van den. Observations of the Nucleus of the Radio Galaxy M82, L19.

Bergh, Sidney van den. *See* DuPuy, Schmitt, McClure, Bergh, and Racine.

Böhm-Vitense, Erika. The Pulsar NP 0532 and the Implications of the Oblique-Rotator Hypothesis, L131.

Brackett-Alpha Emission in Non-LTE Model Stellar Atmospheres (Auer and Mihalas), L151.

Brandt, John C., and Roosen, Robert G. Messier 87: The Galaxy of Greatest Known Mass, L59.

Brundage, W. D. *See* Reifenstein, Brundage, and Staelin.

Buhl, David. *See* Palmer, Zuckerman, Buhl, and Snyder.

Carruthers, George R. Observation of the Lyman Alpha Interstellar Absorption Line in Theta Orionis, L97.

Changes in Polarization of T Tauri Stars (Serkowski), L55.

Comments on "Astrophysical Consequences of Dirac's Hypothesis of a Variable Gravitational Number," by H. Dehnen and H. Hönl (Barnothy), L159.

Corbett, H. H. *See* Hobbs, Corbett, and Santini.

Detection of the $^2\Pi_{3/2}$, $J = \frac{5}{2}$ State of OH at 5-Centimeter Wavelength (Yen, Zuckerman, Palmer, and Penfield), L27.

DuPuy, David, Schmitt, John, McClure, Robert, Bergh, Sidney van den, and Racine, René. Optical Observations of BL Lac = VRO 42.22.01, L135.

Dworetsky, Michael M. Identification of Pt II in the Spectra of Some Peculiar A Stars, L101.

Ekers, R. D., Lequeux, J., Moffet, A. T., and Seielstad, G. A. A Measurement of the Galactic Magnetic Field Using the Pulsating Radio Source PSR 0833−45, L21.

Elldér, J. *See* Rydbeck, Elldér, and Kollberg.

Evidence for the Emission of Energetic Gamma Rays from the Galactic Plane in the Cygnus Region (Valdez and Waddington), L85.

Faraday Rotation in Pulsars (Staelin and Reifenstein), L121.

Fishman, G. J., Harnden, F. R., Jr., and Haymes, R. C. Observation of Pulsed Hard X-Radiation from NP 0532 from 1967 Data, L107.

Formaldehyde Absorption in Dark Nebulae (Palmer, Zuckerman, Buhl, and Snyder), L147.

Friedman, H. *See* Fritz, Meekins, Henry, and Friedman.

Fritz, G., Meekins, J. F., Henry, R. C., and Friedman, H. On X-Ray Line Emission from Scorpius XR-1, L33.

Further Simultaneous Observations of the Optical and X-Ray Spectra of Sco X-1 (Mark, Price, Rodrigues, Seward, Swift, and Hiltner), L67.

Goldwire, H. C., Jr., and Michel, F. C. Analysis of the Slowing-down Rate of NP 0532, L111.

Griem, Hans R. Spontaneous Single-Photon Decay of 2 $^3S_1$ in Helium-like Ions, L103.

Harnden, F. R., Jr. *See* Fishman, Harnden, and Haymes.

Haymes, R. C. *See* Fishman, Harnden, and Haymes.

Henry, R. C. *See* Fritz, Meekins, Henry, and Friedman.

Hiltner, W. A. *See* Mark, Price, Rodrigues, Seward, Swift, and Hiltner.

Hobbs, R. W., Corbett, H. H., and Santini, N. J. Observations of Variable Radio Sources at 9.55-Millimeter Wavelength, L15.

Identification of Pt II in the Spectra of Some Peculiar A Stars (Dworetsky), L101.

Infrared Observations of Eta Carinae to 20 Microns (Westphal and Neugebauer), L45.

Infrared and Optical Measurements of the Crab Pulsar NP 0532 (Neugebauer, Becklin, Kristian, Leighton, Snellen, and Westphal), L115.

Infrared Surveys of the Southern Milky Way. I. Suspected Supergiant Stars (Albers), L37.

Kollberg, E. *See* Rydbeck, Elldér, and Kollberg.

Kristian, J. *See* Neugebauer, Becklin, Kristian, Leighton, Snellen, and Westphal.

Large Optical Polarization of the OH Emission Source VY Canis Majoris (Serkowski), L139.

Leighton, R. B. *See* Neugebauer, Becklin, Kristian, Leighton, Snellen, and Westphal.

Lequeux, J. *See* Ekers, Lequeux, Moffet, and Seielstad.

Lezniak, J., and Webber, W. R. Observations of Fluorine Nuclei in the Primary Cosmic Radiation Made on the Pioneer 8 Spacecraft, L73.

Lü, Phillip K. Positions of Twenty-one Quasi-stellar Objects, L11.

McClure, Robert. *See* DuPuy, Schmitt, McClure, Bergh, and Racine.

Mark, Hans, Price, R. E., Rodrigues, R., Seward, F. D., Swift, C. D., and Hiltner, W. A. Further Simultaneous Observations of the Optical and X-Ray Spectra of Sco X-1, L67.

Measurement of the Galactic Magnetic Field Using the Pulsating Radio Source PSR 0833−45 (Ekers, Lequeux, Moffet, and Seielstad), L21.

Meekins, J. F. *See* Fritz, Meekins, Henry, and Friedman.

Messier 87: The Galaxy of Greatest Known Mass (Brandt and Roosen), L59.

Michel, F. C. *See* Goldwire and Michel.

Mihalas, Dimitri. A Possible Mechanism for Energization of Stellar Winds in Early-Type Stars, L155.

Mihalas, Dimitri. *See* Auer and Mihalas.

Moffet, A. T. *See* Ekers, Lequeux, Moffet, and Seielstad.

Neugebauer, G. *See* Oke, Neugebauer, and Becklin.
Neugebauer, G. *See* Westphal and Neugebauer.
Neugebauer, G., Becklin, E. E., Kristian, J., Leighton, R. B., Snellen, G., and Westphal, J. A. Infrared and Optical Measurements of the Crab Pulsar NP 0532, L115.

Observation of the Lyman Alpha Interstellar Absorption Line in Theta Orionis (Carruthers), L97.
Observation of Pulsed Hard X-Radiation from NP 0532 from 1967 Data (Fishman, Harnden, and Haymes), L107.
Observations of Fluorine Nuclei in the Primary Cosmic Radiation Made on the Pioneer 8 Spacecraft (Lezniak and Webber), L73.
Observations of the Nucleus of the Radio Galaxy M82 (Bergh), L19.
Observations of Variable Radio Sources at 9.55-Millimeter Wavelength (Hobbs, Corbett, and Santini), L15.
OH and Formaldehyde Radiation Properties of the W75 Region (Rydbeck, Elldér, and Kollberg), L141.
Oke, J. B. Photoelectric Spectrophotometry of the Crab Pulsating Radio Source NP 0532, L49.
Oke, J. B., Neugebauer, G., and Becklin, E. E. Spectrophotometry and Infrared Photometry of BL Lacertae, L41.
On the Absorption Spectrum of Ton 1530 (Bahcall, Osmer, and Schmidt), L1.
On X-Ray Line Emission from Scorpius XR-1 (Fritz, Meekins, Henry, and Friedman), L33.
Optical Observations of BL Lac = VRO 42.22.01 (DuPuy, Schmitt, McClure, Bergh, and Racine), L135.
Osmer, Patrick S. *See* Bahcall, Osmer, and Schmidt.

Palmer, Patrick. *See* Yen, Zuckerman, Palmer, and Penfield.
Palmer, Patrick, Zuckerman, B., Buhl, David, and Snyder, Lewis E. Formaldehyde Absorption in Dark Nebulae, L147.
Peebles, P. J. E. *See* Bahcall and Peebles.
Penfield, H. *See* Yen, Zuckerman, Palmer, and Penfield.
Photoelectric Spectrophotometry of the Crab Pulsating Radio Source NP 0532 (Oke), L49.
Positions of Twenty-one Quasi-stellar Objects (Lü), L11.
Possible Mechanism for Energization of Stellar Winds in Early-Type Stars (Mihalas), L155.
Price, R. E. *See* Mark, Price, Rodrigues, Seward, Swift, and Hiltner.
Production of Low-Energy (0.1–10-MeV) Positrons in the Cosmic Radiation (Verma), L79.
Pulsar NP 0532 and the Implications of the Oblique-Rotator Hypothesis (Böhm-Vitense), L131.
Pulsar Scintillations Due to Distant Streaming Cosmic Rays (Wentzel), L91.

Racine, René. *See* DuPuy, Schmitt, McClure, Bergh, and Racine.
Reifenstein, E. C., III. *See* Staelin and Reifenstein.
Reifenstein, E. C., III, Brundage, W. D., and Staelin, D. H. Searches for Pulsars, L125.
Rodrigues, R. *See* Mark, Price, Rodrigues, Seward, Swift, and Hiltner.
Roosen, Robert G. *See* Brandt and Roosen.
Rydbeck, O. E. H., Elldér, J., and Kollberg, E. OH and Formaldehyde Radiation Properties of the W75 Region, L141.

Santini, N. J. *See* Hobbs, Corbett, and Santini.
Schmidt, Maarten. *See* Bahcall, Osmer, and Schmidt.
Schmitt, John. *See* DuPuy, Schmitt, McClure, Bergh, and Racine.

Searches for Pulsars (Reifenstein, Brundage, and Staelin), L125.
Seielstad, G. A. *See* Ekers, Lequeux, Moffet, and Seielstad.
Serkowski, K. Changes in Polarization of T Tauri Stars, L55.
Serkowski, K. Large Optical Polarization of the OH Emission Source VY Canis Majoris, L139.
Seward, F. D. *See* Mark, Price, Rodrigues, Seward, Swift, and Hiltner.
Snellen, G. *See* Neugebauer, Becklin, Kristian, Leighton, Snellen, and Westphal.
Snyder, Lewis E. *See* Palmer, Zuckerman, Buhl, and Snyder.
Spectrophotometry and Infrared Photometry of BL Lacertae (Oke, Neugebauer, and Becklin), L41.
Spitzer, Lyman, Jr. *See* Bahcall and Spitzer.
Spontaneous Single-Photon Decay of $2\ ^3S_1$ in Helium-like Ions (Griem), L103.
Staelin, D. H. *See* Reifenstein, Brundage, and Staelin.
Staelin, D. H., and Reifenstein, E. C., III. Faraday Rotation in Pulsars, L121.
Statistical Tests for the Origin of Absorption Lines Observed in Quasi-stellar Sources (Bahcall and Peebles), L7.
Swift, C. D. *See* Mark, Price, Rodrigues, Seward, Swift, and Hiltner.

Valdez, J. V., and Waddington, C. J. Evidence for the Emission of Energetic Gamma Rays from the Galactic Plane in the Cygnus Region, L85.
Verma, Satya Dev. Production of Low-Energy (0.1–10-MeV) Positrons in the Cosmic Radiation, L79.

Waddington, C. J. *See* Valdez and Waddington.
Webber, W. R. *See* Lezniak and Webber.
Wentzel, Donat G. Pulsar Scintillations Due to Distant Streaming Cosmic Rays, L91.
Westphal, J. A. *See* Neugebauer, Becklin, Kristian, Leighton, Snellen, and Westphal.
Westphal, J. A., and Neugebauer, G. Infrared Observations of Eta Carinae to 20 Microns, L45.

Yen, J. L., Zuckerman, B., Palmer, Patrick, and Penfield, H. Detection of the $^2\Pi_{3/2}, J = \frac{5}{2}$ State of OH at 5-Centimeter Wavelength, L27.

Zuckerman, B. *See* Palmer, Zuckerman, Buhl, and Snyder.
Zuckerman, B. *See* Yen, Zuckerman, Palmer, and Penfield.

THE ASTROPHYSICAL JOURNAL

FOUNDED IN 1895 BY GEORGE E. HALE AND JAMES E. KEELER

Published in Collaboration with the American Astronomical Society

S. CHANDRASEKHAR
Managing Editor
University of Chicago

EDITORIAL BOARD

MAARTEN SCHMIDT (1969-73)
California Institute of Technology

DONALD E. OSTERBROCK (1967-71)
Washburn Observatory

L. WOLTJER (1968-72)
Columbia University

GEORGE W. PRESTON (1966-70)
Mount Wilson and Palomar Observatories

EDWIN E. SALPETER (1965-69)
Cornell University

Editorial Assistant: JEANETTE R. BURNETT

VOLUME 156, PART 1

APRIL–JUNE 1969

THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS

COPYRIGHT 1969
BY THE UNIVERSITY OF CHICAGO
PUBLISHED MONTHLY

COMPOSED AND PRINTED BY THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS, U.S.A.

CONTENTS, PART 1

NUMBER 1

A Magneto-Kinematic Model of the Solar Cycle . . . . Robert B. Leighton 1

On Gravity-coupled Magnetohydrodynamic Waves in the Sun's Atmosphere M. S. Howe 27

On the Possible Emission of Polarized Microwave Radiation from the Solar Hemispheres . Pierre Kaufmann, Oscar T. Matsuura, and P. Marques dos Santos 43

Relative Intensities of Selected Si II Multiplets in the Spectrum of the Sun and ZETA . . . . . Carole Jordan 49

Io, a Jovian Unipolar Inductor . . . Peter Goldreich and Donald Lynden-Bell 59

Comparison of the Reflectivity and Color of Bright and Dark Regions on the Surface of Mars . . . . . Thomas B. McCord 79

Oscillator Strengths and Wavelengths of Some X-Ray and Extreme-Ultraviolet Spectrum Lines of Highly Ionized Iron . . . Robert D. Chapman 87

Rocket Spectrographic Observations of α Virginis . . . Andrew M. Smith 93

High-Dispersion Classification of K2–M6 Giants of High and Low Velocity A. J. Deutsch, O. C. Wilson, and P. C. Keenan 107

Photoelectric Scanner Observations of CH Cygni for August 3, 1967 G. A. H. Walker, S. C. Morris, and P. F. Younger 117

Further Photometry of EX Hydrae . . . . . George S. Mumford 125

Models for the Envelopes of Be Stars . . . . . J. M. Marlborough 135

Non-LTE Model Atmospheres. I. Radiative Equilibrium Models with Lyman-Alpha . . . . . L. H. Auer and Dimitri Mihalas 157

Model Atmospheres for RR Lyrae Stars . . . . . S. E. Strom 177

Radiative Opacity in Stellar Atmospheres. III. Effect of the Hydrogen-to-Helium Ratio on the Atmospheric Structure Satoshi Matsushima and Yoichi Terashita 183

The Structure of White-Dwarf Atmospheres. II. Masses and Radii Determined from Atmospheric Parameters of DA Stars Yoichi Terashita and Satoshi Matsushima 203

The Structure of White-Dwarf Atmospheres. III. The Atmosphere of 40 Eridani B . . . . . Satoshi Matsushima and Yoichi Terashita 219

A Matrix Method for Calculating the Source Function, Mean Intensity, and Flux in a Model Atmosphere . . . . . Robert L. Kurucz 235

The Distance of the Hyades and the Mass-Luminosity Relation . O. J. Eggen 241

The Exterior Solution for Radiating Spheres with Zero Limb Darkening in General Relativity . . . . . William J. Kaufmann, III 257

Polarization of the Continuum Background in Planetary Nebulae Elia M. Leibowitz 261

Galactic H II Regions. IV. 1.95-Cm Observations with High Angular Resolution and High Positional Accuracy . . . . . J. Schraml and P. G. Mezger 269

The Propagation and Anisotropy of Cosmic Rays. I. Theory for Steady Streaming Donat G. Wentzel 303

The Spectrum of Diffuse Cosmic X-Rays, 1–13 keV P. Gorenstein, E. M. Kellogg, and H. Gursky 315

The Peculiar Galaxy NGC 4194 . . . . . Marie-Helene Demoulin 325

Synchrotron Radiation Losses in Self-absorbed Radio Sources Richard McCray 329

Asymptotic Form for Synchrotron Spectra below Razin Cutoff . M. Simon 341

Discrete Source Models To Explain the Microwave Background Radiation A. M. Wolfe and G. R. Burbidge 345

NOTES

The Hoyle-Fowler Model of Quasi-stellar Objects . . J. M. Barnothy 373

A Criterion for Nuclear-energized Pulsational Instability Norman R. Simon and Richard Stothers 377

Optical Backscattering Functions in the Pleiades . . . . C. R. O'Dell 381

Effect of Line Absorption on Main-Sequence Model Stars Catherine J. Cesarsky 385

Chromospheres and Polarization in Late-Type Stars H. Melvin Dyck and Hollis R. Johnson 389

Relative Transition Probabilities for Silicon Myron H. Miller and Roger D. Bengtson 393

Electronic Transition Moments for the Lyman Band of H_2 . J. C. Browne 397

ABSTRACTS OF ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES

Oscillator Strengths, *f*, for High-Level Transitions in Hydrogen Donald H. Menzel 399

NUMBER 2

Activity in the Crab Nebula . . . . . Jeffrey D. Scargle 401

2–20 keV Spectrum of X-Rays from the Crab Nebula and the Diffuse Background near Galactic Anticenter Elihu A. Boldt, Upendra D. Desai, and Stephen S. Holt 427

A Search for Energetic Gamma-Ray Emission from the Supernova Remnant Cassiopeia A . . . . . T. C. May and C. J. Waddington 437

The Effect of Wave-Particle Interactions on the Propagation of Cosmic Rays Russell Kulsrud and William P. Pearce 445

INFRARED PUMPING OF INTERSTELLAR OH . . . . . M. M. Litvak 471

NEUTRAL HYDROGEN IN DARK DUST CLOUDS . . . . . Carl Heiles 493

ROTATION AND MASS OF THE GALAXY NGC 6574
Marie-Helene Demoulin and Y. W. Tung Chan 501

RELATIVISTIC, SPHERICALLY SYMMETRIC STAR CLUSTERS. II. SUFFICIENT CONDITIONS FOR STABILITY AGAINST RADIAL PERTURBATIONS . . . . . James R. Ipser 509

SEISMIC RESPONSE OF THE EARTH TO A GRAVITATIONAL WAVE IN THE 1-Hz BAND
Freeman J. Dyson 529

ON THE PULSATION HYPOTHESIS FOR MASSIVE RED SUPERGIANTS . Richard Stothers 541

STUDIES IN STELLAR EVOLUTION. VIII. THE TIME SCALE FOR THE DIFFUSION OF ENERGY IN THE STELLAR INTERIOR . . . . . Louis Henyey and J. L'Ecuyer 549

SENSITIVITY OF THE SOLAR-NEUTRINO FLUXES
John N. Bahcall, Neta A. Bahcall, and Roger K. Ulrich 559

DYNAMICAL MODELS OF NOVAE . . . . . Warren M. Sparks 569

THE BLUE HORIZONTAL-BRANCH STARS OF NGC 6397
E. B. Newell, A. W. Rodgers, and Leonard Searle 597

A SPECTROSCOPIC STUDY OF THE ASSOCIATION SCORPIUS OB 1
Rudolph E. Schild, W. A. Hiltner, and N. Sanduleak 609

FAINT CEPHEIDS IN CYGNUS AND MONOCEROS . . . . . Olin J. Eggen 617

THE SPECTRUM OF α^2 CANUM VENATICORUM, 5000–6700 Å
Judith G. Cohen, Armin J. Deutsch, and Jesse L. Greenstein 629

THE MAGNETIC FIELD AND LIGHT VARIATIONS OF 17 COMAE BERENICES AND κ CANCRI
George W. Preston, Kazimierz Stepien, and Sidney Carne Wolff 653

ZEEMAN OBSERVATIONS OF METALLIC-LINE STARS . . . . . Peter S. Conti 661

SPECTROGRAPHIC AND PHOTOMETRIC ANALYSES OF HR 7484
Michael S. Snowden and Robert H. Koch 667

NON-LTE MODEL ATMOSPHERES. II. EFFECTS OF BALMER α
L. H. Auer and Dimitri Mihalas 681

MODEL ATMOSPHERES FOR O-TYPE STARS WITH ULTRAVIOLET LINE BLANKETING
Philip T. Bradley and Donald C. Morton 687

COMPUTED PROFILES FOR SOLAR Mg b- AND Na D-LINES
R. Grant Athay and Richard C. Canfield 695

THERMAL GENERATION OF HYDROMAGNETIC WAVES IN SUNSPOTS . . Blair D. Savage 707

A CORONAL ENHANCEMENT IN THE EXTREME ULTRAVIOLET
W. J. Boardman and D. E. Billings 731

PHYSICAL PROPERTIES OF λ5303 CORONAL EMISSION REGIONS
Donald E. Billings and Jo Ann Joselyn 739

DISSOCIATION OF MOLECULES BY THE ABSORPTION OF LINE RADIATION
Michael W. Werner 753

THE RADIO-FREQUENCY SPECTRUM OF H_2^+ . . . . . S. K. Luke 761

NOTES

The High-Velocity Cloud Complexes as Extragalactic Objects in the Local Group . . . . . G. L. Verschuur 771

On the Theoretical $(U - B)$- and $(B - V)$-Colors Satoshi Matsushima and David L. Hall 779

Photoelectric Observations of ET Pegasi . . . . . B. Basu 785

Transport Coefficients in the Chromosphere and Coronal Gas. II. Thermal Conductivity . . . . . A. Delcroix and A. Lemaire 787

Transition Probabilities for the Swan and Mulliken C_2 Bands William Hayden Smith 791

ABSTRACTS OF ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES

Synthesis of the Elements within Objects Exploding from Very High Temperatures . . . . . Robert V. Wagoner 795

Thermal Conduction by Electrons in Stellar Matter W. B. Hubbard and Martin Lampe 795

α^2 Canum Venaticorum and the Oblique-Rotator Theory . . Diane M. Pyper 796

ERRATA

A Search for O_2 on Mars and Venus: A Possible Detection of Oxygen in the Atmosphere of Mars . . . . . M. J. S. Belton and D. M. Hunten 797

On the Spiral Structure of Disk Galaxies. III. Comparison with Observations C. C. Lin, C. Yuan, and Frank H. Shu 797

NUMBER 3

Intergalactic H I Emission at 21 Centimeters . A. A. Penzias and R. W. Wilson 799

Some Implications of the Anisotropy Measured in the Microwave Background A. M. Wolfe 803

Polarization of Discrete Sources at 21.2-cm Wavelength, and Galactic Depolarization . . . . . J. M. Bologna, E. F. McClain, and R. M. Sloanaker 815

Quasi-stellar Objects and the Density of Intergalactic Hydrogen Peter D. Noerdlinger 841

Distribution of H II Regions in Irregular Galaxies . . . . Paul W. Hodge 847

The Globular Clusters NGC 2808 and NGC 1851 . . . . . Gonzalo Alcaino 853

Measurements of Magnetic Fields in Interstellar Clouds of Neutral Hydrogen G. L. Verschuur 861

Conditions for Microwave Radiation from Excited OH Λ-Doublet States M. M. Litvak, B. Zuckerman, and D. F. Dickinson 875

Determinations of Helium Abundance from Radiofrequency Recombination Lines. Patrick Palmer, B. Zuckerman, H. Penfield, A. E. Lilley, and P. G. Mezger 887

Ionization Stratification and Chemical Abundances in the Planetary Nebula NGC 7662 . . . . . J. Patrick Harrington 903

The General Solution of the b_n Problem for Gaseous Nebulae
T. J. Sejnowski and Robert M. Hjellming 915

Results of Five Nights of Continuous Monitoring of the Optical Flux from Sco X-1 . . . . . Allan Sandage, J. A. Westphal, and Jerome Kristian 927

The Interaction of X-Ray Sources with Optically Thin Environments
C. Bruce Tarter, Wallace H. Tucker, and Edwin E. Salpeter 943

The Interaction of X-Ray Sources with Optically Thick Environments
C. Bruce Tarter and Edwin E. Salpeter 953

The Magnetic Field of HD 215441 . . . . . George W. Preston 967

Rotational Velocities in the Open Cluster NGC 6475 (M7)
Helmut A. Abt and Clifford P. Jewsbury 983

On the Pressure-induced Opacity of Molecular Hydrogen in Late-Type Stars
Jeffrey L. Linsky 989

Curve-of-Growth Analysis for the Close Binary HR 5317
Yoji Kondo and George E. McCluskey, Jr. 1007

Spectroscopic Binaries and Collapsed Stars
Virginia L. Trimble and Kip S. Thorne 1013

Evolution of Initially Pure ^{12}C Stars and the Production of Planetary Nebulae
G. S. Kutter and M. P. Savedoff 1021

Differential Rotation in Stars on the Upper Main Sequence
Maurice J. Clement 1051

The Effect of Quantum Correlations on Electron-Scattering Opacities
M. O. Diesendorf and B. W. Ninham 1069

On the Equation of State of a Relativistic Fermi-Dirac Gas at High Temperatures . . . . . Robert F. Tooper 1075

Long-Wavelength Turbulence and the Heating of the Solar Wind
J. R. Jokipii and Leverett Davis, Jr. 1101

Stochastic Variations of Cosmic Rays in the Solar System . . . J. R. Jokipii 1107

Interplanetary Gas. XVI. A Calculation of the Angular Momentum of the Solar Wind . . . . John C. Brandt, Charles Wolff, and Joseph P. Cassinelli 1117

High-Resolution Interferometry of Venus at 3.12-cm Wavelength
G. L. Berge and E. W. Greisen 1125

A Particulate Thermophysical Model of the Lunar Soil
D. F. Winter and J. M. Saari 1135

Absolute *gf*-Values for Fe I and Fe II Lines
Gary L. Grasdalen, Martin Huber, and W. H. Parkinson 1153

NOTES

The Nature of the Variability of HD 19216 . . . . . George W. Preston 1175

The Solar [Fe II] Lines . . . . . George L. Withbroe 1177

Remarks on Half-Space Applications regarding an Equation of Transfer for a Planetary Atmosphere . . . . . C. E. Siewert 1181

ABSTRACTS OF ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES

Revision of the Ultraviolet Solar Spectrum 3650–3000 Å
Walter E. Mitchell, Jr., and Orren C. Mohler 1185

Binary Stars among Cataclysmic Variables. X. Photoelectric Observations of EM Cygni . . . . . George S. Mumford and W. Krzeminski 1185

INDEX TO VOLUME 156, PART 1 1187

THE ASTROPHYSICAL JOURNAL

FOUNDED IN 1895 BY GEORGE E. HALE AND JAMES E. KEELER

Published in Collaboration with the American Astronomical Society

S. CHANDRASEKHAR
Managing Editor
University of Chicago

EDITORIAL BOARD

MAARTEN SCHMIDT (1969–73)
California Institute of Technology

DONALD E. OSTERBROCK (1967–71)
Washburn Observatory

L. WOLTJER (1968–72)
Columbia University

GEORGE W. PRESTON (1966–70)
Mount Wilson and Palomar Observatories

EDWIN E. SALPETER (1965–69)
Cornell University

Editorial Assistant: JEANETTE R. BURNETT

VOLUME 156, PART 2

APRIL–JUNE 1969

THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS

COPYRIGHT 1969
BY THE UNIVERSITY OF CHICAGO
PUBLISHED MONTHLY

COMPOSED AND PRINTED BY THE UNIVERSITY OF CHICAGO PRESS
CHICAGO, ILLINOIS, U.S.A.

CONTENTS, PART 2

NUMBER 1

On the Absorption Spectrum of Ton 1530
John N. Bahcall, Patrick S. Osmer, and Maarten Schmidt L1

Statistical Tests for the Origin of Absorption Lines Observed in Quasi-stellar Sources . . . . . John N. Bahcall and P. J. E. Peebles L7

Positions of Twenty-one Quasi-stellar Objects . . . . . Phillip K. Lü L11

Observations of Variable Radio Sources at 9.55-Millimeter Wavelength
R. W. Hobbs, H. H. Corbett, and N. J. Santini L15

Observations of the Nucleus of the Radio Galaxy M82 . Sidney van den Bergh L19

A Measurement of the Galactic Magnetic Field Using the Pulsating Radio Source PSR 0833−45 R. D. Ekers, J. Lequeux, A. T. Moffet, and G. A. Seielstad L21

Detection of the $^2\Pi_{3/2}$, $J = \frac{5}{2}$ State of OH at 5-Centimeter Wavelength
J. L. Yen, B. Zuckerman, Patrick Palmer, and H. Penfield L27

On X-Ray Line Emission from Scorpius XR-1
G. Fritz, J. F. Meekins, R. C. Henry, and H. Friedman L33

Infrared Surveys of the Southern Milky Way. I. Suspected Supergiant Stars
Henry Albers L37

Spectrophotometry and Infrared Photometry of BL Lacertae
J. B. Oke, G. Neugebauer, and E. E. Becklin L41

Infrared Observations of Eta Carinae to 20 Microns
J. A. Westphal and G. Neugebauer L45

Photoelectric Spectrophotometry of the Crab Pulsating Radio Source NP 0532
J. B. Oke L49

NUMBER 2

Changes in Polarization of T Tauri Stars . . . . . K. Serkowski L55

Messier 87: The Galaxy of Greatest Known Mass
John C. Brandt and Robert G. Roosen L59

Absorption Lines Produced by Galactic Halos
John N. Bahcall and Lyman Spitzer, Jr. L63

Further Simultaneous Observations of the Optical and X-Ray Spectra of Sco X-1
Hans Mark, R. E. Price, R. Rodrigues, F. D. Seward, C. D. Swift, and W. A. Hiltner L67

Observations of Fluorine Nuclei in the Primary Cosmic Radiation Made on the Pioneer 8 Spacecraft . . . . . J. Lezniak and W. R. Webber L73

Production of Low-Energy (0.1–10-MeV) Positrons in the Cosmic Radiation
Satya Dev Verma L79

Evidence for the Emission of Energetic Gamma Rays from the Galactic Plane in the Cygnus Region . . . . . J. V. Valdez and C. J. Waddington L85

Pulsar Scintillations Due to Distant Streaming Cosmic Rays
Donat G. Wentzel L91

Observation of the Lyman Alpha Interstellar Absorption Line in Theta Orionis
George R. Carruthers L97

Identification of Pt II in the Spectra of Some Peculiar A Stars
Michael M. Dworetsky L101

Spontaneous Single-Photon Decay of 2 $^3S_1$ in Helium-like Ions . Hans R. Griem L103

NUMBER 3

Observation of Pulsed Hard X-Radiation from NP 0532 from 1967 Data
G. J. Fishman, F. R. Harnden, Jr., and R. C. Haymes L107

Analysis of the Slowing-down Rate of NP 0532
H. C. Goldwire, Jr., and F. C. Michel L111

Infrared and Optical Measurements of the Crab Pulsar NP 0532
G. Neugebauer, E. E. Becklin, J. Kristian, R. B. Leighton, G. Snellen, and J. A. Westphal L115

Faraday Rotation in Pulsars . . . . D. H. Staelin and E. C. Reifenstein III L121

Searches for Pulsars . E. C. Reifenstein III, W. D. Brundage, and D. H. Staelin L125

The Pulsar NP 0532 and the Implications of the Oblique-Rotator Hypothesis
Erika Böhm-Vitense L131

Optical Observations of BL Lac = VRO 42.22.01
David DuPuy, John Schmitt, Robert McClure, Sidney van den Bergh, and René Racine L135

Large Optical Polarization of the OH Emission Source VY Canis Majoris
K. Serkowski L139

OH and Formaldehyde Radiation Properties of the W75 Region
O. E. H. Rydbeck, J. Elldér, and E. Kollberg L141

Formaldehyde Absorption in Dark Nebulae
Patrick Palmer, B. Zuckerman, David Buhl, and Lewis E. Snyder L147

Brackett-Alpha Emission in Non-LTE Model Stellar Atmospheres
L. H. Auer and Dimitri Mihalas L151

A Possible Mechanism for Energization of Stellar Winds in Early-Type Stars
Dimitri Mihalas L155

Comments on "Astrophysical Consequences of Dirac's Hypothesis of a Variable Gravitational Number," by H. Dehnen and H. Hönl . . . Jeno Barnothy L159

Index to Volume 156, Part 2 . . . . . L161